

TO ALTER DNA OR NOT TO ALTER DNA?

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We now have the potential to eradicate many human diseases through genome editing. But if we had the ability to do the same for our most superficial characteristics, should we allow it? CRISPR technology is the latest advancement in medicine and biology, but as we learn what capabilities we have, we're also learning how little we know. As we move forward, we must recognize the potential harm – both immediate and lasting – and establish ethical norms and regulations for genome editing.

CRISPR-Cas9 is a tool for “cutting out” sections of DNA. We adapted it from the natural mechanisms of bacteria and other single-celled organisms after Mikihiro Shibata of Kanazawa University and Hiroshi Nishimasu of the University of Tokyo described the process in 2017. The “CRISPR” in CRISPR-Cas9 is an acronym for “clusters of regularly interspaced short palindromic repeats,” whereas the “Cas9” refers to the protein that does the actual cutting. According to an article in *Live Science*, the process of genome editing “can be done by inserting a cut or break in the DNA and tricking a cell's natural DNA repair mechanisms into introducing the changes one wants.” This allows us to alter something that has been subject to nature since living organisms have existed.

The primary application of CRISPR-Cas9 at the moment is to eradicate genetic diseases. But the potential for such technology is vast and isn't limited to human beings. Its applications have already been considered for food and agriculture. For instance, crops can be changed to be less impacted by elements of their environment. Foods can be made to resist viruses. Imagine a world where farmers aren't as concerned with drought because their crop can thrive in spite of it.

Those possibilities, and ones we have yet to consider, are reason enough to move forward with implementing CRISPR technology, though not without certain negative consequences. "[T]he biggest limitation of CRISPR is it is not a hundred percent efficient," said George Church, a professor of genetics at Harvard Medical School, in an interview with Live Science. Unfortunately, not all intended targets of CRISPR-Cas9 are affected, resulting in imprecise edits Church calls "genome vandalism." For now, our knowledge of CRISPR technology remains incomplete which means we must be careful in how we use it until further information is gathered.

In 2017, the National Academy of Sciences and the National Academy of Medicine presented a report on the ethics of genome editing. In it, they state that while future clinical trials for genome editing may one day be permitted, only "serious conditions under stringent oversight" should be allowed at this point. The concern they present is one of modifications affecting not only the patient but their offspring. This limits clinical trials to non-heritable cells with the intention of preventing disease and disability. That way, future generations aren't robbed of their consent.

Chinese researcher He Jiankui announced in 2018 that he had genetically edited embryos with the help of two colleagues to remove the possibility of the children contracting HIV/AIDS despite having a parent with the virus. Despite He's noble intentions, he was sentenced to three years in jail for "forging ethical review documents and [misleading] doctors into unknowingly implanting gene-edited embryos." The children, who were born in November 2018, hopefully won't experience any complications, but if they do, it may not be possible to reverse the damage. Hence, the National Academies' report.

Ethics are an important part of any emerging technology, especially one that affects individuals. No matter how eager we may be to make giant leaps, we cannot do so without establishing the proper protocols and procedures that keep everyone safe. CRISPR-Cas9 is an awesome advancement in medicine with limitless potential but not at the expense of our humanity.