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FOR ENGINEERING AND SCIENCE

Case: Genome Editing & the Ethics of CRISPR-Cas9

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Description

This historical case uses the April 2015 publication on editing the genomes of non-viable human embryos by Junjiu Huang et. al. to explore the ethical issues surrounding the development of gene editing technologies and application to humans.

Body

In April 2015, scientists in China published a paper in an online journal, *Proteins & Cells*, about experiments editing the genomes of non-viable human embryos (Liang et al. 2015). The research team, led by Junjiu Huang, used an engineered enzyme complex, called CRISPR-Cas9, to target and edit the HBB gene that codes for human β -globin protein. Defects in that gene can lead to β -thalassaemia, a heritable blood disorder that can be fatal.

In 2012, scientists Jennifer Doudna and Emmanelle Charpentier developed the CRISPR-Cas9 bioengineered complex that was used by the researchers in China. The technology has been used in previous research on animal and adult human cells. The technology allows researchers to target a specific gene by binding and splicing

the DNA at specific locations, and replacing or repairing the segment by inserting other molecules (Cyranoski & Reardon 2015).

In their research, Huang and his team used non-viable, single-cell human embryos, which they obtained from a fertility clinic. The embryos possessed an extra set of chromosomes because they had been fertilized by two sperm and thus could not develop beyond the first stages of development. Huang and colleagues' aim was to test whether the technology could reliably target defective genes and replace these genes with repaired sequences. Their results showed that only a small fraction of the 86 embryos used in the study had the replaced genetic material at the targeted gene. The researchers also found that there were many "off-target" mutations that might have been introduced in the genome as a by-product of the technological intervention (Cyranoski & Reardon 2015). These results led the researchers to conclude that clinical applications of the technology to human embryos were still premature.

The authors of the paper also claimed that the prestigious journals, *Science* and *Nature*, rejected their paper because of ethical objections to their research on human embryos, and specifically, because of ethical objections to any kind of germ line genetic modification. The editors at the journal, *Proteins & Cells*, justified publishing the paper by claiming that they verified the researchers' institutional approval and the consent forms from the embryo donors, and confirmed that the study was compliant with Chinese laws and the Declaration of Helsinki's set of ethical principles on human experimentation (Cressey & Cyranoski 2015).

Were the editors at *Science* and *Nature* right to decline to publish the research paper? Should the editors at *Protein & Cells* have refrained from publishing the paper? Should the individual scientists have conducted and reported their research at all? Did they violate any moral duties or obligations? Given the paper is now published, what should members of the scientific community do?

Discussion Questions:

- Leading scientists called for a moratorium on research on human embryos using genome-editing technologies, such as CRISPR. What sorts of ethical concerns does a moratorium address? What are some goals that could be

achieved? What do you think are the likely outcomes or consequences of a moratorium and of the technology?

- Why did the editors at *Science* and *Nature* decided not to publish the paper? Were the editors at *Protein & Cells* too hasty in publishing the research on embryos? How should academic journals deal with potentially controversial research? What are their moral and social responsibilities?
- Should non-scientist members of the public be included in the decision-making process about whether or not, and to what extent, research with genome-editing technologies should be restricted? What kinds of concerns might be overlooked if the decision-making process included only scientists? What sorts of insights may non-scientist members of the public bring to the discussion?
- What should be the social and ethical responsibilities of the individual scientists involved in research with genome-editing technology? How can they best fulfill those responsibilities?

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Links

Embryo-Editing: The Ethics of CRISPR on Flipboard:
<https://flipboard.com/@naturenewsteam/embryo-editing%3A-the-ethics-of-crispr-27j1164kz>

The National Academies of Sciences, Engineering, and Medicine - *On Human Gene Editing: International Summit Statement*:
<http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=12032015a>

Notes

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