Gene Editing Technology and Ethical Issues

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INTRODUCTION

Technologies for making accurate additions, deletions, and alterations to DNA—have generated interest across the world because of the promise it holds to improve human health. For example, genome editing is being tested in clinical trials to engineer immune cells to target cancerous tumor cells and to make cells more resistant to HIV. Genome editing could also be used to develop new treatments for devastating genetic diseases like Huntington's disease, sickle cell anemia, immune deficiencies, muscular dystrophy, and cystic fibrosis. Technology as tool view is only part of the story about the complex relationships between technology, society, and ethics. This is why technologies, are also complex social phenomena. Some technologies are encouraged by society through social demand or public funding. (Sandler R.L. 2014) This is often the case with medical technologies, while some technologies are opposed or rejected by society (or at least by some members of society)

Important inquiries have been raised about human genome editing and balancing potential benefits with the risk of unintended harms and using this type of technology while incorporating societal values into clinical applications and policy decisions. Furthermore, respecting the inevitable differences across nations and cultures that will shape diverse perspectives regarding these technologies. The recent development and growing use of the CRISPR/Cas9 system have resulted in an explosion of research in genome editing. Clinical trials are testing how these technologies can be used to improve health.

BACKGROUND

Five years ago University of California, Berkeley, biochemist Jennifer Doudna, and colleagues unveiled the gene-editing tool CRISPR (Science 2012). Doudna's lab, in fact, was engaged in a patent fight with the Harvard- and MIT-affiliated Broad Institute.

The patent case turns on the question of which researchers at the two institutions conceived of the most important CRISPR applications first. UC says it's a team at its Berkeley lab headed by Jennifer Doudna, with the collaboration of Emmanuelle Charpentier, now of Germany's Helmholtz Centre for Infection Research. Broad's claim is based on the work of its researcher Feng Zhang.

The patent office changed its rules to a "first-to-file" basis from the old "first-to-invent," in 2013, making the U.S. the last major country to do so. The idea was to end disputes that turned on minute interpretations of lab records or personal notes, with costs that arguably disadvantaged small inventors.

Last February 2017, the U.S. Patent Trial and Appeal Board ruled that although a team led by UC Berkeley structural biologist Jennifer Doudna had first laid claim to the use of CRISPR to cut DNA in a

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test tube, the use of the method on human cells by molecular biologist Feng Zhang's team at the Broad was still an advance.

However, a decision from the European Patent Office (EPO) in January 2018 revoked the patent from the Broad Institute of MIT and Harvard University because the Broad did not meet EPO requirements to establish that its researchers were the first to use CRISPR in eukaryotes. The patent granted to the Broad for fundamental aspects of the technology is one of several of its patents facing opposition in Europe.

Genome editing (also called gene editing) is a group of technologies that give scientists the ability to change an organism's DNA. These technologies can add, alter, or genetic material at particular locations in the genome. Several approaches to genome editing have been developed. Once the DNA is cut, researchers use the cell's own DNA repair machinery to add or delete pieces of genetic material, or altering the DNA by replacing an existing segment with a customized DNA sequence.

Genome editing is of great interest in the prevention and treatment of human diseases. It is being explored in research on a wide variety of diseases. It also holds promise for the treatment and prevention of a more complex disease, such as human immunodeficiency virus (HIV) infection.

Figure 1.

Clustered Regularly Interspaced Short Palindromic Repeats

One of most recent gene editing technology getting a lot of attention is CRISPR-Cas9. The CRISPR-Cas9 system has generated a lot of enthusiasm in the scientific community because it is faster, cheaper, more accurate, and more efficient than other existing genome editing methods.

CRISPR technology is a simple yet powerful tool for editing genomes. It allows researchers to easily alter DNA sequences and modify gene function. Its many potential applications include correcting genetic defects, treating and preventing the spread of diseases and improving crops. However, its promise also raises ethical concern (Vidyasagar A 2018).

CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats, which is a sequence of base pairs found in the DNA of bacteria that have this feature. Some bacteria and archaea use CRISPR