Threat of DNA engineering of humans and genetic extinction technologies by US and China

Within only a few years, research labs worldwide have adopted a new technology referred to as “CRISPR,”that facilitates making specific changes in the DNA of humans, other animals, and plants. Compared to previous techniques for modifying DNA, this new approach is much faster and easier. CRISPR allows removing a single (defective) gene from a genome and replacing it with another one, to prevent genetic diseases.

US and China are leaders in applications of CRISPER technology.

A US military agency DARPA is investing $100m in genetic extinction technologies that could wipe out malarial mosquitoes, invasive rodents or other species, emails released under freedom of information rules show. Cutting-edge gene editing tools such as Crispr-Cas9 work by using a synthetic ribonucleic acid (RNA) to cut into DNA strands and then insert, alter or remove targeted traits. These might, for example, distort the sex-ratio of mosquitoes to effectively wipe out malarial populations.

In 2016, a Chinese group has become the first to inject a person with cells that contain genes edited using the revolutionary CRISPR–Cas9 technique. Earlier Scientists of Chinese Kunming Biomedical International and its affiliated Yunnan Key Laboratory of Primate Biomedical Research used CRISPR to create a pair of macaque monkeys with precise genetic mutations. Chinese scientists say they were among the first in using Crispr to make wheat resistant to a common fungal disease, dogs more muscular and pigs with leaner meat.

The introduction of CRISPR, which is simpler and more

efficient than other techniques, will probably accelerate the race to get gene-edited cells into the clinic across the world, says Carl June, who specializes in immunotherapy at the University of Pennsylvania in Philadelphia and led one of the earlier studies. “I think this is going to trigger ‘Sputnik 2.0’, a biomedical duel on progress between China and the United States, which is important since competition usually improves the end product,” he says.

China is leading in applying CRISPER

On 28 October, a team led by oncologist Lu You at Sichuan University in Chengdu delivered the modified cells into a patient with aggressive lung cancer as part of a clinical trial at the West China Hospital, also in Chengdu. Lu’s team extracted immune cells called T cells from the blood of the enrolled patients, and then disabled a gene in them using CRISPR–Cas9, which combines a DNA-cutting enzyme with a molecular guide that can be programmed to tell the enzyme precisely where to cut. The disabled gene codes for the protein PD-1, which normally puts the brakes on a cell’s immune response: cancers take advantage of that function to proliferate. Lu’s team then cultured the edited cells, increasing their number, and injected them back into the patient, who has metastatic non-small-cell lung cancer. The hope is that, without PD-1, the edited cells will attack and defeat the cancer.

Normally, a parent organism with a given trait passes that genetic code to offspring about half the time. Recent advances combining the gene-editing tool CRISPR–Cas9 are now making it easier for scientists to modify a genome such that nearly all offspring inherit the desired trait.

Recently, China announced it was genetically engineering hyper-muscular SUPER-DOGS.The dogs, which are test tube bred in a lab, have twice the muscle mass of their natural

counterparts and are considerably stronger and faster. An army of super-humans has been a staple of science fiction and superhero comics for decades – but the super-dog technology brings it closer to reality. The beagle puppy, one of 27, was genetically engineered by 'deleting' a gene called myostatin, giving it double the muscle mass of a normal beagle.

The advance genetic editing technology has been touted as a breakthrough which could herald the dawn of 'superbreeds', which could be stronger, faster, better at running and hunting. The Chinese official line is that the dogs could potentially be deployed to frontline service to assist police officers. Dr Lai Liangxue, researcher at Guangzhou institute of biological medicine and health, said: "This is a breakthrough, marking China as only the second country in the world to independently master dog-somatic clone technology, after South Korea."

China has had a reputation for moving fast – sometimes too fast – with CRISPR, says Tetsuya Ishii, a bioethicist at Hokkaido University in Sapporo, Japan. Ishii notes that if the clinical trial begins as planned, it would be the latest in a series of firsts for China in the field of CRISPR gene editing, including the first CRISPR-edited human embryos, and the first CRISPR-edited monkeys. "When it comes to gene editing, China goes first," says Ishii.

Threat of Military applications of gene editing technology

Scientists have learned how to harness CRISPR technology in the lab to make precise changes in the genes of organisms as diverse as fruit flies, fish, mice, plants and even human cells. Researchers are using crispr to knock out genes in animal models to study their function, give crops new

agronomic traits, synthesize microbes that produce drugs, create gene therapies to treat disease, and to genetically correct heritable diseases in human embryos.

CRISPR “has transformed labs around the world,” says Jing-Ruey Joanna Yeh, a chemical biologist at Massachusetts General Hospital’s Cardiovascular Research Center, in Charlestown, who contributed to the development of the technology. “Because this system is so simple and efficient, any lab can do it.” Editing with CRISPR is like placing a cursor between two letters in a word processing document and hitting “delete” or clicking “paste.” And the tool can cost less than US $50 to assemble.

However, CRISPR is also known to cause gene edits at the wrong place in the genome, which could potentially cause some harmful effects. There is also threat of potential harm to environment.

The steep fall in the costs of gene-editing toolkits has created a greater opportunity for hostile or rogue actors to experiment with the technology. This has led to growth of Global Biohackers, a term for biologists who work outside of traditional labs and sell genetic engineering kits. Terrorists could employ them to make Bio weapons or lethal viruses.

CRISPER is also being used in military applications. During the second biennial Department of Defense Lab Day May 18, 2017, One AFRL exhibit, called Military Applications of Gene Editing Technology, highlighted research into how geneticists and medical researchers edit parts of the genome by removing, adding or altering sections of the DNA sequence in order to remove a virus or disease caused by harmful chemical, biological or environmental agents a warfighter may have contact with.

Jim Thomas, a co-director of the ETC group which obtained the emails, said the US military influence they revealed would

strengthen the case for a ban. “The dual use nature of altering and eradicating entire populations is as much a threat to peace and food security as it is a threat to ecosystems,” he said. “Militarisation of gene drive funding may even contravene the Enmod convention against hostile uses of environmental modification technologies.”

Human Gene Manipulation using CRISPR

CRISPR has been used to edit animal embryos and adult stem cells, but until Chinese trial, no one has reported using the technique to edit the genome of human embryos due to ethical issues.

In UK CRISPR is considered a controversial topic, with doubts that it could result in ‘designer babies’ if exploited.The rise of genetic screenings of human embryos allow scientists to create organisms by design, rather than leave it up to chance. This has also been made simpler by genetic sequencing technology that has expanded humanity’s genetic toolbox dramatically.

While in US an advisory panel of the US National Institutes of Health (NIH) has approved a planned US trial that would also use CRISPR–Cas9-modified cells for the treatment of cancer. The US researchers have said they could start their clinical trial by the end of this year.

Chinese team also reported that out of 71 of the embryos used in the CRISPR experiment the technique worked properly on just a fraction of the total, and only small percentage of those managed to relay the new gene properly when they split. They also found that sometimes the procedure wound up splicing the wrong gene segment, which led to inserting new genes in the wrong places—which in normal embryos could lead to a new

disease.

The most dramatic possibility raised by the primate work, of course, would be using CRISPR to change the genetic makeup of human embryos during in vitro fertilization. Pentagon scientists are researching gene manipulation to build the soldiers of tomorrow that will be able to run at Olympic speed, and won't need food or sleep. It will also be possible to trigger the cells of injured soldiers' bodies to rebuild lost limbs.

Using Crispr to cure disease "is probably ethical," said Eric Hendrickson, a professor at the University of Minnesota Medical School, whose research uses Crispr techniques for DNA repair. "To use that technology to make your child run faster or jump higher is uniformly frowned upon. The technology to do that, however, will soon be in place."

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