

Scientists debate boundaries, ethics of human gene editing

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In this photo provided by UC Berkeley Public Affairs, taken June 20, 2014, Jennifer Doudna, right, and her lab manager, Kai Hong, work in her laboratory in Berkeley, Calif. Designer babies or an end to intractable illnesses: A revolutionary technology is letting scientists learn to rewrite the genetic code, aiming to alter DNA in ways that, among other things, could erase disease-causing genes. How far should these experiments try to go—fix only the sick, or make changes that future generations could inherit? (Cailey Cotner/UC Berkeley via AP)

Rewriting your DNA is getting closer to reality: A revolutionary technology is opening new frontiers for genetic engineering—a promise of cures for intractable diseases along with anxiety about designer babies.

Hundreds of scientists and ethicists from around the world are gathering in Washington this week to debate the boundaries of human gene editing, amid worry that the fast-moving research may outpace safety and ethics scrutiny.

It's a question that gained urgency after Chinese researchers made the first attempt at editing genes in human embryos, a laboratory experiment that didn't work well but did raise the prospect of one day altering human heredity—passing modified DNA to future generations.

"This is a technology that could have profound implications for permanent alteration of the human genome," molecular biologist Jennifer Doudna of the University of California, Berkeley, wrote in the journal *Nature* on the eve of the international summit.

Doudna co-invented the most-used gene-editing tool, and her calls for scientists, policymakers and the public to determine the right balance in how it's eventually used led to this week's gathering.

At issue are tools to edit precisely genes inside living cells, finding specific sections of DNA to slice and repair or replace much like a biological version of cut-and-paste software. There are a few methods but one with the wonky name CRISPR-Cas9 is so fast, cheap and simple for biologists to use that research is booming.

Scientists are engineering animals with humanlike disorders to unravel the gene defects that fuel them. They're building stronger immune cells, and developing potential treatments for muscular dystrophy, sickle cell

disease and cancer. They're trying to grow transplantable human organs inside pigs. They're even hatching mutant mosquitoes designed to be incapable of spreading malaria, and exploring ways to wipe out invasive species.

As for that preliminary embryo research, it's nowhere near ready for real-world use, but there's controversy over whether and how to continue such experiments to see if it eventually will work.

On one side are scientists who say the ultimate goal is to prevent mom and dad from passing devastating diseases to their children.

"This technology is poised to transform preventive medicine," Harvard geneticist George Church wrote in *Nature*.

He added a warning: If mainstream scientists can't explore heritable gene editing, that "could put a damper on the best medical research and instead drive the practice underground to black markets and uncontrolled medical tourism."

Doudna adds that a complete ban on such research could block important discoveries. British researchers, for example, plan to alter embryos to study early human development, work that could shed light on miscarriages.

On the other side are critics who say that so-called germline editing—altering sperm, eggs or embryos to affect future generations—has been widely regarded as a line science shouldn't cross. They argue that standard in vitro fertilization techniques to test the genetics of embryos before they're implanted, or before adoption, are alternatives. And they raise the specter of parents who can afford designer babies with specific traits.

"The medical arguments are tenuous and the possible social consequences are grave," said Marcy Darnovsky of the Center for Genetics and Society advocacy group.

In the U.S., the National Institutes of Health has said it won't fund human germline editing research, although private funding is still possible. Laws and guidelines in other countries vary widely.

More information: Human gene-editing initiative:
[nationalacademies.org/genome-edits-summit/index.htm](https://www.nationalacademies.org/genome-edits-summit/index.htm)

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