



Personal Genetics Education Project

Ethical, Legal and Social Issues in Personal Genetics

SNAPSHOT

Genome Editing & Organ Transplants



HARVARD
MEDICAL SCHOOL

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GENETICS**

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SNAPSHOT

Genome Editing & Organ Transplants

Big Picture

- There is an extreme shortage of organs for people who need donations and scientists are challenged with finding a solution.
- How might genome editing help us create more organs suitable for human transplant?

There is a [massive shortage](#) of organs for people who need donations. Pigs hold a great deal of promise as possible donors, as many pig organs and human organs are similar in size and structure. However, serious challenges persist for potential recipients due to risks of immune rejection, problems with bleeding and clotting, and viral infection. Scientists are using a genome editing technique called CRISPR to alter pig DNA in an effort to address these issues. ([Click here](#) to watch a short video explaining how CRISPR works.) To prevent rejection of transplanted organs, researchers removed several pig genes that trigger a human immune response and introduced new genes that inhibit the immune response and others that regulate blood clotting. Additionally, the team used genome editing to disable viruses that are embedded in the pig genome (called porcine endogenous retroviruses or PERVs). By making these edits to lower the risk of an immune response or infection, people may be more likely to respond well to a transplanted organ from a pig. Increased availability of organs for transplantation could potentially save thousands of lives annually.

The pigs that have undergone genome edits are reported to be healthy and preliminary results seem to indicate that organs from these animals are significantly less likely to trigger an immune response in humans than those of unmodified pigs. To further test whether these modified pig organs will be safe and suitable for eventual transplantation into humans, the research team has transplanted these pig organs into monkeys.

For more, see "[Eyeing organs for human transplants, companies unveil the most extensively gene-edited pigs yet](#)" by Kelly Servick, December 2019, *Science*.

In 2019, burn specialists at Massachusetts General Hospital were the first to transplant genetically modified living-cell tissue from a pig to a human. Standard treatment for severe burns involves temporarily transplanting skin from a donor onto the burn site while preparing skin for permanent donation from elsewhere on the patient's own body (typically the thigh). Researchers in this case used a two-inch square piece of pig skin to temporarily cover the burn. [The experiment](#) was a success with the transplanted pig skin indistinguishable from the skin right next to it from a deceased human donor (known as a cadaver).

While pork producers have [shown interest](#) in joining efforts to supply engineered pig organs for human transplantation, this approach raises a number of social and ethical concerns. Animal rights activists worry about the harming and exploitation of animals. The choice of animals in which the organs are produced may present cultural or religious challenges for certain communities. There are also questions about whether the organs will be available to patients in a fair and equitable fashion. Others worry about the first group of people who agree to such a transplant – will human bodies accept these organs, long term? Will the organs actually function for a length of time that justifies the risks and expense? While organs from genetically modified pigs offer one possible solution to the shortage of transplant organs, scientific challenges and ethical considerations remain.

Student Worksheet

Name: _____

Date: _____

1. Visit <https://www.organdonor.gov/statistics-stories/statistics.html> to see current organ donation statistics.
 - a. How many people are currently on the organ transplant waiting list?
 - b. How many transplants were performed last year?
 - c. How many people die each day waiting for a transplant?
2. Why do some scientists think we may be able to use pig organs for human transplantation?
3. What changes would need to be made to the pig organs to make them safer for human transplantation?
4. Why do you think skin was chosen to be the first living-cell pig-to-human transplant tissue?
5. What concerns might people have about using pig organs for human transplantation?