

The New York Times: “For Patients Needing Transplants, Hope Arrives on Tiny Hooves” [C2]

Trapiantare organi di maiali geneticamente modificati negli esseri umani? La scienza avanza, tra sfide mediche e dilemmi etici.

On a 300-acre [121 hectares] farm in an [undisclosed](#) location in rural Wisconsin, surrounded by fields [dotted](#) with big red [barns](#) and [bordered](#) by [wild blue chicory](#) and [goldenrod](#), live some of the most [pampered](#) pigs in the world. They are delivered by [C-section](#) to protect them from viruses that [sows](#) can carry, and [bottle-fed](#) instead of [nursed](#) for the same reason. They are kept under warming lights and monitored [around the clock](#) for the first days of their lives, given toys and marshmallows as [treats](#). But they don't get to go outside and play in the dirt like other pigs. They are clones and constitutionally weak, genetically-engineered to have [kidneys](#), hearts and [livers](#) more compatible with the human body. These miniature pigs are part of a [bold](#) scientific experiment that takes advantage of breakthroughs in cloning and gene editing to realize the centuries-old dream of xenotransplantation — the transfer of animal [kidneys](#), hearts, [livers](#) and other organs into humans who need them. Success could [bring riches](#) to the two biotech companies that are leaders in this space, the Cambridge, Massachusetts-based eGenesis and the Blacksburg, Virginia-based Revivacor, owned by United Therapeutics Corp. The demand for organs is huge. More than 100,000 Americans are on waiting lists for donor organs, most needing a kidney. Only 25,000 human donor [kidneys](#) become available each year. Twelve Americans on the kidney list die every day on average. Scientists first transplanted genetically-engineered pig organs into other animals and then to brain-dead human patients. In 2022, researchers received permission to transplant the organs into a few critically ill patients, and then, last year, into healthier people. Now, for the first time, a formal clinical study of the procedure is being initiated. “Just imagine, you have kidney disease and know your [kidneys](#) are going to fail, and you have a pig's kidney waiting for you — and you never see dialysis,” said Mike Curtis, president and CEO at eGenesis. Some scientists argue that there is a moral imperative to move forward. But critics say xenotransplantation is a

[hubristic, pie-in-the-sky endeavour](#) aiming to solve an organ shortage with technology when there's a simpler solution: expanding the supply of human organs by encouraging more donation. And xenotransplantation is [freighted](#) with unanswered questions. Pigs can carry pathogens that can find their way to humans. If a deadly virus, for example, were to emerge in transplant patients, it could spread with catastrophic consequences. It might be years or even decades before symptoms were observed, [warned](#) Christopher Bobier, a bioethicist from the Central Michigan University College of Medicine. "A potential zoonotic transference could happen at any point after a transplant — in perpetuity," he said. The risk is believed to be small, he added, "but it is not zero." No one knows how much an organ from a genetically-engineered pig might cost, and whether insurance plans would cover it. But many patients with organ failure, [tethered](#) to a dialysis machine four hours every other day, see in these small pigs hope for a return to normal life. Scientists chose to use organs from genetically-modified pigs, rather than chimps or [baboons](#), for a simple reason: pigs are easier [to raise](#) and mature in six months, and the size of their organs is compatible with adult humans. Scientists at eGenesis first transplanted the pig [kidneys](#) into macaque monkeys. But would it work in humans? In 2021, scientists tried to find out, taking a radical approach that seemed [plucked](#) from a sci-fi novel. With the consent of the families, the researchers transplanted pig [kidneys](#) into patients who were brain-dead and maintained on ventilators, then [tracked](#) how their bodies responded. The novel idea has been attributed to Dr. Thomas Starzl, widely known as the father of modern transplantation, who died in 2017. Two pioneering surgeons tried it, though neither knew what the other was up to. One was Dr. Robert Montgomery, a charismatic surgeon at NYU Langone in New York City who is himself alive thanks to a heart transplant. He used an organ from a Revivicor pig with a single gene [knocked out](#) and [thymus gland tissue](#) attached. The second surgeon was Dr. Jayme Locke, then at the University of Alabama at Birmingham, who trained under Montgomery. Locke didn't make a public announcement, waiting until her paper was published in a medical journal. She used a kidney from a pig with six added human genes and four of its own silenced to prevent rejection. Soon after the pig [kidneys](#) were attached to the brain-dead patients, the organs started functioning as a human's would — making

urine and clearing a [waste product](#) called creatinine from the blood. In early 2022, a fifty-seven-year-old patient in Maryland became the first human to receive a heart [harvested](#) from a genetically-modified pig, produced by Revivacor. David Bennett had a life-threatening arrhythmia and had been [hooked up](#) to a heart-lung bypass machine. But he had [run out](#) of treatment options and was not even allowed on the waiting list for a human donor heart because of his history of not following doctors' orders. When Dr. Bartley Griffith, a surgeon at the University of Maryland Medical Center, offered him the pig's heart, he wasn't sure that Bennett understood. Then Bennett asked, "Will I [oink](#)?" The new heart started [pumping](#) after it was implanted, and Bennett's body didn't [turn on](#) it, at least not right away. But his immune system eventually mounted a very aggressive response, and he died about two months later. The official cause of death was heart failure, but his poor health had limited the use of anti-rejection drugs, Griffith and his colleague Dr. Muhammad Mohiuddin said. In September 2023, a second terminally ill man opted to receive a pig's heart. Lawrence Faucette, of Frederick, Maryland, had advanced heart failure. Faucette, fifty-eight, survived for only six weeks after the procedure, but his wife, Ann Faucette, said she had no [regrets](#). "It's like you're in the middle of the ocean, and you have a choice of staying there to be eaten by sharks or having pirates rescue you, and then at least you have a chance," Ann Faucette said. The deaths may have [signaled](#) failure to the general public, but the xenotransplant community was optimistic. Neither of the patients experienced a [dreaded outcome](#), hyperacute rejection, when the body attacks and destroys a transplanted organ, turning it black within hours, even minutes. In November, Towana Looney, fifty-three, from Gadsden, Alabama, was sitting in her dialysis chair when she got the call she had been waiting for ever since she heard news reports about pig [kidneys](#) years earlier. Looney had kidney failure. But she also carried antibodies that made organ rejection likely, meaning she probably would not receive a donated human kidney. Locke was calling to tell her that a pig's kidney was waiting for her in New York. "I said, 'But what about Christmas?'" Looney recalled in an interview. "Locke said, 'This is going to be the best Christmas present you ever got.'" The new kidney changed Looney's life. She no longer needed dialysis, and she could urinate again. Her blood pressure normalized, her nausea

subsided, her appetite roared back to life, and she was able to walk nine or ten city blocks at a clip. “Dialysis took so much out of me, I felt like I had to fight to live,” she said over dinner recently. “Now my voice is strong, my energy is strong, I sound different — it’s a win-win.” Looney was the first patient to make it to the three-month mark, and she flew home to Alabama last month. Some critics object to cloning animals for their organs as unethical. Still, the United States raises almost 150 million hogs for consumption each year. For now, caregivers at the eGenesis facility in Wisconsin are making sure the coddled pigs live their best lives. The animals, which are very social, always have ‘snout-to-snout’ contact with other pigs. And they are well fed, even though they often pretend that they missed a feeding. The caregivers, who grow attached to the pigs, know that most of them will be sacrificed for research or transplantation as soon as they mature, but they believe in the mission. “We know what they’re being used for is so important,” said Haley Rymut, the manager of donor resources. “We know their lives are changing the world.” © 2025 The New York Times Company. **This article originally appeared in **The New York Times**. **

Glossary

- **pampered** = coccolati, viziati
- **nursed** = allattare
- **oink** = grugnire
- **regrets** = rimpianti
- **caregivers** = assistenti
- **undisclosed** = segreta
- **wild blue chicory** = cicoria selvatica
- **thymus gland tissue** = tessuto della ghiandola del timo
- **hooked up** = collegare
- **roared back to life** = riprendere vigore
- **hogs** = maiali
- **goldenrod** = verga d'oro
- **C-section** = cesareo
- **bring riches** = far arricchire
- **pie-in-the-sky endeavour** = progetto irrealizzabile, utopico
- **outcome** = risultato
- **subsided** = placarsi, diminuire
- **at a clip** = senza fermarsi
- **dreaded** = temere
- **dotted** = punteggiare
- **barns** = fienili, granai
- **around the clock** = 24 ore su 24
- **kidneys** = reni
- **livers** = fegati
- **knocked out** = eliminare
- **turn on** = rivoltarsi contro, rigettare
- **snout-to-snout** = muso a muso
- **grow attached** = affezionarsi
- **bold** = audace
- **freighted** = pieno
- **to raise** = allevare
- **sows** = scrofe
- **waste product** = prodotto di scarto

- **harvested** = prelevare, raccogliere
- **signaled** = indicare
- **bottle-fed** = allattati artificialmente, con biberon
- **treats** = snack
- **baboons** = babbuini
- **plucked** = estrarre
- **tracked** = monitorare
- **pumping** = pompare
- **bordered** = circondare
- **hubristic** = arrogante
- **warned** = avvertire
- **tethered** = attaccare, legare
- **run out** = esaurire
- **coddled** = viziare