The Artificial Heart

Answer these Pre-Reading questions before you begin reading:

1. Why is the heart such an important organ?

2. What problems do you think were encountered when they attempted to build an artificial heart?

3. When do you think an artificial heart would be needed?

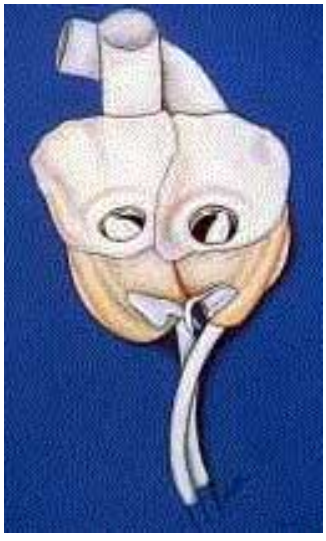
4. What are other options for people who need a heart?

The Artificial Heart

Beating more than 2.5 million times over the course of an average lifetime, the human heart is the hardest working organ in the body- and the most vital. Its failure is often the event that ends our lives. Each year in the United States, approximately 45,000 people need heart transplants. But with fewer than 3,000 donor hearts available each year, the artificial heart has long been one of the Holy Grails of medicine. Though early experimentation left the public disenchanted with artificial hearts, a new generation of man-made devices promises to extend the lives of hundreds of thousands in the coming decades.

Early Attempts

In 1964, faced with sky-high levels of heart disease among the general population, the National Heart Institute allocated $600,000 for the development of a permanent artificial heart by 1970. By 1969, Dr. Denton Cooley of Baylor Medical College in Texas implanted the first artificial heart into an Illinois man.



The two-chambered device functioned much like a natural heart with one big exception. It was powered by enormous air pumps outside of the body, using hosesto pass through the patient's body wall and into the circulatory system.

Haskell Karp lived for just three days supported by this Liotta artificial heart.

According to his wife: "I saw an apparatus going intothe arms, the hands, the feet. He could not say anything.I don't think that he was really conscious. I see him lying there breathing, and knowing that within his chest is a man-madeimplement where there should be a God-given heart."

The incident was not without controversy. Cooley had performed the operation without permission from any regulatory body or even his mentor, Dr. Michael DeBakey. In the wake of the bad publicity, Cooley resigned from Baylor, and the public began to consider the artificial heart more monstrous than miraculous.

Nearly twenty years would pass before another artificial heart recipient would inspire hope among doctors and the general public alike. In 1982, Dr. William DeVries of the University of Utah implanted a 61 year-old-dentist named Barney Clark with an artificial heart called Jarvik 7. Since Clark was too sick to be eligible for a donated heart, Clark's implant would be permanent.

The procedure was a media event. But though Clark's implant prolonged his life, it also robbed him of his freedom. Like Karp's temporary heart, Jarvik 7 was an air-driven pump, and Clark was bound to the washing machine-sized air compressor that powered it. As with Karp, tubes from the compressor passed through Clark's chest wall, binding him to his bed and causing constant infections. What's more, Clark's blood kept clotting as it passed through the imperfect man-made pump. Clark suffered a number of strokes before he died 112 days after his implantation. Again the public, and the politicians allocating public funds, turned against the notion of an artificial heart.

As hopes for a total artificial heart (TAH) faded, surgeons worked to perfect heart transplantation. Today, 86 percent of patients who receive a donor heart survive for at least one year after the procedure. More than 70 percent of patients live at least four years. But the shortage of donor organs continues to force doctors to seek other ways of mending broken hearts.

For nearly two decades, mechanical devices designed to assist, not replace, weakened hearts have helped people stay healthy while they wait for an organ donation. Called LVADs, or left ventricle assist devices, the pumps take the strain off the left ventricle, the hardest working chamber of the heart, whose job it is to pump oxygen-rich blood throughout the entire body. Though power cords and vents still jut out from the patient's stomach, the portable battery power source allows the person some degree of freedom and mobility.

Furthermore, there is some evidence that the restful break L-VADs give an ailing heart might be enough to essentially "cure" heart disease in some people. In August 2000, California-based Thoratec Laboratories reported that some thirty to forty patients appear to have recovered from their heart disease while using the company's L-VAD. The patients, at hospitals around the world, were implanted with the device while awaiting a heart transplant. But within 10 to 190 days, doctors found that many of the patient's

heart conditions had dramatically improved, to the point that they no longer required a transplant or continued use of the L-VADs.

"It was originally thought [heart disease] was completely irreversible," says David Farrar, head of Research and Development at Thoratec. "Now people are starting to work on how to find out who's going to recover and who's not."

Thoratec estimates as many as five million Americans could benefit from their device; no longer as a bridge to transplant, but as a bridge to recovery. FDA approval to use the device for "therapeutic recovery" is pending.

THE NEXT GENERATION OF ARTIFICIAL HEARTS

As in every other arena, advances in technology pave the way for smaller, sleeker, more efficient artificial hearts. Today, teams of scientists from various disciplines- including NASA engineers- race to design the next generation of artificial hearts.

PIG PARTS

While some researchers have been seeking a mechanical means of replacing or repairing ailing hearts, other scientists are looking to a more home grown alternative. Natural as it may seem, xenotransplantation is equally fraught with scientific quandaries, ethical dilemmas and bad publicity.

Xenotransplantation is the use of animal organs in humans. In 1964, doctors first placed a chimpanzee's heart into a human being. The organ functioned for only two hours before the recipient's immune system rejected it, a complication even in human to human transplants. But recent developments in genetic engineering might present the solution scientists have been looking for since 1905.

Primates like chimpanzees and baboons are the animals most closely related to humans. That makes them the best and the worst possible organ donors. Their size and blood types mean primate organs are most compatible with our own and are least likely to be rejected; however, primate viruses could also take advantage of the similarities between chimps and humans and make the leap into human populations. Add to that the endangered status of chimpanzees, and it's clear why scientists are looking to a less cherished species as organ donors.

Each year, more than 90 million pigs are slaughtered for food in the United States. Since they are less closely related to humans, pig organs are more likely to be rejected, but less likely to transmit viruses. Today, bioengineers are working to make pig organs more acceptable to the human immune system by altering the pig's genetic make up. By adding human immunity genes to and removing certain pig genes from the cells of fetal pigs, researchers hope to breed a strain of pigs whose organs would go unnoticed by a human recipient's immune system.

But scientists are in a bind. Bioengineering pigs could provide more than enough compatible organs each year, but the greater the usage, the greater the risk of transmitting viruses between species. Scientists can't yet agree on which poses the bigger threat to society- the risk of virus transmission or the loss of hundred's of thousands of people with AIDS, Parkinson's Disease, spinal cord injuries, diabetes, liver failure, muscular dystrophy or even psoriasis who could benefit from animal tissue transplants. The dilemma is an ethical one, forcing scientists to choose between the health of an individual and the health of society at large. As with the artificial heart, public opinion and allocation of funds will have much to do with its resolution.

Excerpted from PBS

Go back to your pre-reading questions and see if you agree with your answers. Write a paragraph summary and answer the question:

Should the U.S. government continue to support and fund the artificial heart programs? Why or why not? Use data from this reading to support your argument.