

# Smithsonian's 'bionic man' features artificial heart, prototype body parts

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Frank's skeleton looks like it was made in a bike shop, his arms and hands operate on batteries and a computer program lets him have an "almost human-like conversation."

Frank is a bionic man, built for a Smithsonian Channel special about state-of-the-art manmade body parts gathered from around the globe.

Bertolt Meyer, host of the documentary, was at the National Air and Space Museum with Frank on Thursday to tout the documentary that will air Sunday on the Smithsonian Channel. Frank will remain on display at the museum through December, when he will be dismantled and his parts returned to the organizations that donated them for the project.

But the SynCardia temporary Total Artificial Heart that pumps plastic blood through his plastic veins was made in Tucson, Ariz., and it is the only one of Frank's internal organs that is more than a prototype.

"All the other bits that we see here, like the [artificial pancreas](#) here, the first prototype of an artificial kidney, spleen and lung - they're all still prototypes and still have a very long way to go," said Meyer. "Whereas the [heart](#) is already being used in patients."

Michael Garippa, chief executive officer of Tucson-based SynCardia Systems Inc., which manufactured Frank's heart, said the opportunity to work with the Smithsonian was "too good to say no to."

"I think this was a real honor for us and a great chance for technology that's largely been kept under a rock to get a lot of extra attention," Garippa said.

Meyer, a social psychologist at the University of Zurich in Switzerland, said the documentary was "first and foremost an educational project," meant to show viewers the latest developments in the field. But it was also an education for him.

"I was absolutely stunned," he said of the progress in prosthetics and artificial [body parts](#).

Meyer, who was born without the lower part of his left arm and uses a prosthetic himself, said he hopes the program will also spark a conversation about what continuing development in this area could mean for society.

"What if an [artificial heart](#) can buy us more lifespan - what will a society like that look like?" Meyer asked. "These (questions) kind of alter the ethical implications of this technology."

While some of the developments may seem like science fiction, much of it is closer to science fact, said Dr. Daniel Tang, a surgeon at the Virginia Commonwealth University Medical Center, who is featured in the documentary.

"Have we gotten to the point where mechanical pumps can replace a heart transplant?" Tang asked. "It's close."

The Total Artificial Heart is used to temporarily replace a human heart for a patient awaiting a transplant, sometimes for years, Tang said. Though it has been around largely in the same form since 1981, he said, the manmade heart like that in Frank is a "miracle of medicine" at a time

when there are not enough human hearts available for transplant.

"The amount of donor hearts that are available is far overshadowed by the number of people on the waitlist," Tang said. "That kind of discrepancy only continues to grow."

The SynCardia heart has been implanted in about 1,200 patients worldwide since the 1980s, pumping real blood through real veins - unlike the plastic blood it pumps for Frank. Garippa said it is the only device approved in the U.S., Canada and the European Union for treatment of heart failure involving both ventricles.

In the past, patients with the device had to stay in the hospital "tethered" to a 500-pound console, Tang said, driving up costs and limiting how many people could get the manmade heart. But a relatively new 13.5-pound portable device makes it possible for patients to go home.

Garippa said the portable device has passed Food and Drug Administration trials and he hopes it will get full FDA approval in November. If approved, the new device would reduce costs and hardships associated with protracted hospital stays, he said.

The SynCardia heart is also becoming more widely available, with the number of centers certified to implant it soon to increase from nearly 90 to 125 worldwide, a number that Garippa said will ultimately reach about 400.

Tang sees a day when artificial organs may be made of synthetic tissue instead of metal and plastic.

"It's an amazing time we're living in," Tang said.

## **THE BODY ECLECTIC**

"Frank" is not a complete person - he is missing key parts like a brain, digestive system and skin - but he brings together in one "body" more than a dozen manmade parts. In addition to the SynCardia temporary Total Artificial Heart, Frank's parts list includes:

- Skull implants printed with a 3D printer.
- The Argus II system that turns video into electrical impulses the brain can "see."
- NeoSpeech software and a chatbot computer program that turns text into speech and lets Frank have "almost human-like conversation."
- A cochlear implant that turns sound into electrical impulses.
- A 3D-printed synthetic windpipe that can use a patient's stem cells to prevent rejection.
- An artificial lung that filters air and oxygenate blood.
- An artificial pancreas that helps regulate blood-sugar in diabetics without insulin injections.
- A blood substitute made of plastic molecules with an iron atom at their core that carries oxygen, but does not fully replace human blood.
- A manmade spleen, still under development, that filters toxins from the bloodstream.
- Battery-powered prosthetic arms.
- Touch Bionic i-Limb prosthetic hands.

- Prosthetic hips that rotate up to 130 degrees.
- Knees that adjust to different environments with the help of gyroscopes, accelerometers and microprocessors.
- BiOM ankles invented by a rock-climbing biophysicist and engineer.
- The Rex exoskeleton that helps Frank "walk" and may one day replace wheelchairs.

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