

## Inside the beating heart

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Paul Iaizzo, Ph.D., Director of the University of Minnesota's **Visible Heart Laboratory**, has given the medical world a unique, never-before-seen view inside the beating heart. Part of the **Medical School's** Experimental Surgical Services, the lab has reanimated hundreds of hearts, including about 50 human hearts, using a clear, artificial blood that lets tiny camera-equipped catheters record every movement from the inside.

Iaizzo, who holds the Medtronic Visible Heart Research Professorship and collaborates with scientists and engineers from the medical device company, has personally reanimated more than 1,000 swine hearts and the 50 or so human specimens, which have been collected into a one-of-a-kind heart library to share with other researchers. Video and images from the lab have been used in textbooks and conference presentations around the world, and they've helped give biomedical engineers important new insights into the heart's functional anatomy.



Images and videos taken in the Visible Heart Lab give biomedical engineers around the world important insights into the heart's functional anatomy. (Photo: Brady Willette)

At first, Iaizzo says, he had ethical concerns about reanimating human hearts, but after riding along with Life-Source, our region's organ donation service, to visit with families, he learned that people wanted their loved ones' remains to be used to help advance science. (These hearts have all been deemed nonviable for transplantation, and families have approved their use for research.)

Respecting the donors' wishes, Iaizzo pushes himself and his students to collect as much data as possible for as long as the heart is beating, even if it means working late into the night.

"you really feel committed to getting as much information from the specimens as you can," he says. "It's a huge privilege."

And the work doesn't stop there. Once they've finished gathering data, which usually takes six to 10 hours, Iaizzo and his students begin editing video and images to publish on the lab's anatomy tutorial website, which is used by thousands of students, teachers, designers, and medical professionals each year.

Next the hearts are fixed in formalin, then they go through both a CT scan and MRI. Finally, they are returned to the lab's heart library, where more than 240 human hearts (including many that could not be reanimated) line the shelves in numbered containers. It's one of the largest collections of perfusion-fixed heart specimens in the world.

Students and teachers use the library regularly, and it also attracts medical device designers, who

can use the hearts to see firsthand how a device prototype interacts with the anatomy of different heart types and sizes.

“you can see for yourself how complicated this organ is,” says laizzo. “A lot of different companies bring in teams of design engineers. They’ll hold and study the hearts. They may put a catheter inside. As long as it’s nondestructive to the specimen, we allow them to do that.”

In fact, design engineers don’t need to come to the lab in person. The CT and MRI scans are used to produce detailed image maps, which can be shared electronically and used to print near-exact replicas of the hearts with a 3-D printer. laizzo holds up one plastic model printed by Boston Scientific, a gift for giving the company access to the 3-D files. Other images and materials can be downloaded from the lab’s Atlas of Human Cardiac Anatomy ([www.vhlab.umn.edu/atlas](http://www.vhlab.umn.edu/atlas)), a widely used, free, online tool produced in collaboration with LifeSource.

“We get thank-you letters from anatomists all over the world,” says laizzo. “We’re highly motivated to share ... with everybody.”

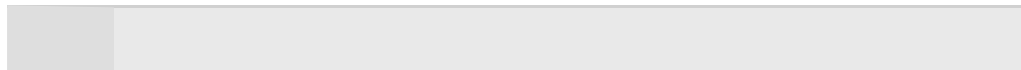
*To support work under way in the Visible Heart Laboratory, contact Amanda Storm Schuster at 612-626-2475 or [a.schuster@mmf.umn.edu](mailto:a.schuster@mmf.umn.edu), or visit [www.mmf.umn.edu/giveto/vhlab](http://www.mmf.umn.edu/giveto/vhlab).*

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