

## 3-D Bioprinter Makes Beating Heart Tissue



Patients with heart failure who aren't faring well on cardiac medication but also aren't candidates for complex cardiac surgeries could one day have their hearts repaired with cardiac patches being created at Johns Hopkins Medicine.

Pediatric cardiac surgeon Narutoshi Hibino is using a 3-D bioprinter to create cardiac tissue that could one day surgically patch damaged hearts.

"This technology is much simpler compared to a heart transplant or ventricular assist device," says Hibino. "It has the potential to improve patient quality of life."

To treat damaged heart tissue, some researchers have been studying the efficiency of stem cell injections; others are developing cardiac patches that contain man-made elements, like engineered scaffolding upon which the tissue grows.

Hibino's cardiac muscle does not contain scaffolding. The tissue is created by a 3-D printer that helps form stem cells into tiny balls and then inspects them for their uniformity. Then, much like a series of miniature shish kebabs, the printer skewers the cell balls on an array of needles. The printer's Japanese manufacturer

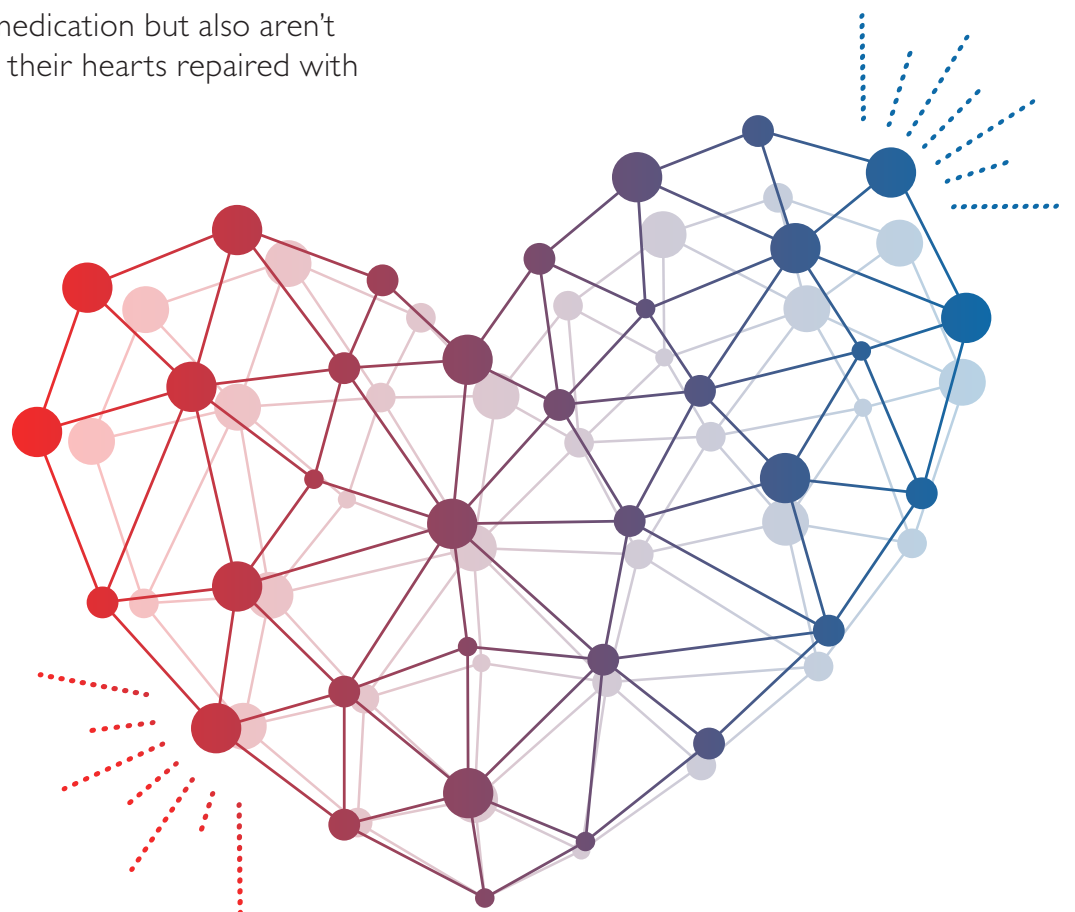
refers to this as the "kenzan method" because the printer's collection of needles look similar to a kenzan, the spiky pad used to arrange plants in traditional Japanese flower arranging.

Those cells fuse together after a few days. The needles are then carefully pulled out, leaving beating heart tissue that can live for a month in a lab dish.

Hibino hopes to begin testing the tissue patches in rats next year.

The 3-D printer is not dedicated to a particular research core, but Hibino says it's available for other Johns Hopkins Medicine research projects in Baltimore, like creating samples of organs that can then be used as three-dimensional testing material to study the efficiency of new drugs. Hibino can be reached at [nhibino1@jhmi.edu](mailto:nhibino1@jhmi.edu).

**WEB EXTRA:** See how the printer works by clicking on this [article at hopkinsmedicine.org/insight](http://hopkinsmedicine.org/insight).



## State-of-the-Art CT Machine Better Captures Joint Injuries



When a patient injures his or her ankle or knee, the impact on the joint and surrounding tissue can be difficult for doctors to gauge. That's because conventional CT and MRI scanners image patients while lying down, sometimes missing problems that are only evident when the joint is in a functional, weight-bearing state.

A newly available CT scanner addresses both of these limitations. It was developed by Johns Hopkins researchers in the departments of Biomedical Engineering, Radiology and Radiological Science, and Orthopaedic Surgery, and the Division of Rheumatology, in collaboration with Carestream. Called the OnSight 3D Extremity System, the scanner creates higher-quality images with low radiation exposure and allows a patient's knees, ankles and feet to be imaged while the patient is standing.

The scanner design was based on mathematical models for 3-D image quality developed by Johns Hopkins researchers. This allowed them to understand and optimize trade-offs in resolution, contrast and dose.

"With this scanner, we see clear delineation of bone details as well as cartilage, tendons and ligaments sufficient for many radiological examinations," says Jeff Siewerdsen, the biomedical engineering professor who led early development at Johns

Hopkins. "The high level of image quality is a result of both rigorous system design and novel algorithms for artifact correction and 3-D image reconstruction."

This means it's easier to spot injuries that may have gone undetected, like damaged soft tissue or ligaments. Physicians could then provide more tailored treatment.

The scanner's smaller size and cost also mean clinics could offer one-stop joint imaging and consultation.

The system won the 2016 Aunt Minnie Award for Best New Radiology Device and was approved by the Food and Drug Administration in September 2016. Johns Hopkins Technology Ventures is licensing the technology in partnership with Carestream.

Siewerdsen says the research has led to several new projects focusing on osteoarthritis and post-radiotherapy fracture risk, spearheaded by biomedical engineer Wojciech Zbijewski and clinical collaborators.







A look at innovative developments outside the halls of Johns Hopkins Medicine

TECH//ENVY

## It's in the Material

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**S**cientists from various institutions, including Harvard Medical School and MIT, have incorporated microscopic sensors into thread to gather diagnostic data. The threads are dipped in compounds that can sense shifts in temperature, glucose and blood pressure. In rats, the smart thread accurately relayed information to a wireless computer. The researchers hope to employ the thread to monitor how a stitched-up wound is healing and catch any infections. 🐭

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**R**esearchers at the University of North Carolina have devised a material that could be folded up, inserted into the body and programmed to change into a certain shape at the right time and place. The shape-shifting stuff doesn't need any external trigger to change form. Rather, it relies on two types of chemical bonds: one that controls how it shifts shapes, and one that stores information on the final shape. Such a material could be used for medical implants for bones or joints. 🐭

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**A**fter researchers at Rice University fused microscopic flakes of graphene oxide together, scientists at the University of Texas cultured cells on the material to show it could be used as a strong, flexible bone replacement. An alternative to titanium, the graphene oxide bends more easily to create the complex shapes of human bones and exhibits the strength needed to endure everyday stress on the body's skeleton. 🐭

## Tracking Resident Orders to See If They're Reducing Unnecessary Tests



Does showing residents the number of hospital tests they order in comparison to their peers encourage them to order more appropriately?

Physicians in the Department of Medicine will find out, thanks to a soon-to-be-launched dashboard that uses Epic data to track the number of tests residents order for patients. The dashboard focuses on residents because they manage most hospitalized Department of Medicine patients, but it could one day be broadened to include faculty members.

"There's no way to change behavior if you don't know what your behavior is," says Lenny Feldman, an internist who helped create the dashboard with fellow internist Amit Pahwa and the Johns Hopkins Technology Innovation Center.

The Buffy Care dashboard (named after Buffy the Vampire Slayer) focuses on tracking blood tests and imaging, like CT and MRI scans. Residents can compare their test-ordering behavior to those of their anonymous peers. The dashboard is part of a growing interest around the country for hospitals to provide high-value health care—delivering the best outcomes at the lowest cost. Feldman and Pahwa are both directors on the Johns Hopkins Department of Medicine High Value Care Committee.

For now, the dashboard does not include information on cost or whether residents correctly ordered. Select chief residents will have access to the data for feedback purposes.



Feldman and Pahwa acknowledge that residents' ordering patterns may be affected by the nature and degree of their patients' illnesses. Nevertheless, they hope that by making residents aware of their practices, they'll be more inclined to ensure the tests they order are necessary for patients' care.

The team used U.S. Health Resources and Services Administration funding to contract the Technology Innovation Center to build the dashboard. Pahwa says the final hurdle is making sure data are accurate before the dashboard's launch in 2017.

## Collaboration with Facebook Multiplies Potential Organ Donors by 6



When liver transplant surgeon Andrew Cameron caught up with friend and former classmate Sheryl Sandberg, they discussed the plight of people on the organ transplant waiting list. As the chief operating officer for Facebook, Sandberg had some ideas about how social media could help people on the list identify organ donors.

"There are 100,000 people on the wait list in the U.S.," says Cameron. "The reason is they are often hesitant to tell their story. As a result, their friends and family don't even know what's going on with them."

Sandberg suggested the development of an app to guide people to write their stories. The app would ask questions, the user would answer them, and a carefully crafted story would result and be posted on Facebook. In addition, the app would automatically include links to reputable information on becoming a living donor. Cameron loved the idea.

"The one-way communication of a post on Facebook is noncoercive, and there is no pressure to respond one way or another," he says. "If a person is inclined to be a living organ donor, there are links to information to facilitate the next steps."

Facebook sponsored the first rendition of the mobile app and, in 2016, Cameron gave 53 of his patients on the transplant waiting list access to it. As a result, people who used the app were six times more likely to identify a potential donor than those who didn't use it.

Now, Cameron is leading a two-year study at three medical centers comparing the results of using the app, using the standard approach to finding a donor and using the app plus another means of finding living donors.

