

Use drones to deliver organs for transplant? Baltimore surgeon says it would save precious time, money

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At a Southern Maryland airfield, Dr. Joseph Scalea watched a drone

carrying a kidney in a cardboard cooler fly 3 miles.

The [test flight](#), repeated 14 times, was the culmination of three years' work by the University of Maryland Medical Center transplant surgeon, who sees the unmanned aircraft as the ultimate method for delivering life-saving organs from donors to recipients.

"I did a transplant where the organ flew 1,500 miles from Alabama on a [commercial aircraft](#) and it took 29 hours," Scalea said. "That's ridiculous. It could have been here in six. And yet that's accepted as how we do things."

Organs don't last long outside the body, and delays and mistakes mean some lose quality or can't be transplanted. Scalea is frustrated that the system relies on couriers, commercial airline schedules and costly charter flights arranged by local nonprofit agencies. He cited a recent \$80,000 charter to deliver a liver to Baltimore from Texas and an unrelated case in which a heart was accidentally left on a commercial plane flying from Seattle.

That led Scalea to try to jump to the head of a movement already underway to resolve the technical, regulatory and medical hurdles to using drones to shepherd [medical supplies](#) such as blood, medicines, and now body parts, anywhere around the country at any time.

More than 30,000 organs such as kidneys and livers are transplanted a year, and many more valves, bones and other tissues. Scalea expects drones to overcome the barriers and remake how organs are delivered in the next three to five years.

"It will be faster and cheaper and more predictable," said Scalea, also an assistant professor of surgery in Maryland's school of medicine. "Drones really work for this purpose."

For now, hobbyists still dominate drone use in the United States. The Federal Aviation Administration has registered almost a million recreational users. The FAA reports that public agencies and commercial users are catching up, with 290,000 drones registered and performing such tasks as wildfire mapping, agricultural and weather monitoring, disaster management and law enforcement. Other uses include utility inspection, telecommunications and real estate photography.

The FAA still strictly enforces limits on drone use, requiring waivers to fly at night, over populated areas, out of a pilot's sight, faster than 100 mph or above 400 feet. But the agency plans changes based on a program it launched in May with 10 local government agencies.

"Data gathered from these pilot projects will form the basis of a new regulatory framework to safely integrate drones into our national airspace," Transportation Secretary Elaine Chao said at the time, adding that the new industry was expected to generate 100,000 jobs and \$82 billion in economic impact in less than a decade.

At least two programs plan to distribute medical supplies, including a pilot program by North Carolina's transportation department that will use a drone fleet operated by San Francisco-based Zipline.

The company already delivers cold-packed medical supplies in Rwanda. Officials said their drones transport more than 30 percent of the country's blood supply outside of the capital Kigali, helping to eliminate maternal deaths at some hospitals, and expansion to other African countries is planned. They aim to test the same system in North Carolina this year.

The tests will help change the U.S. regulations, which are more stringent than those in developing countries, said Matt Scassero, director of the University of Maryland Unmanned Aircraft System Test Site in St.

Mary's County.

Another challenge is that drones capable of flying organs across the country aren't yet commercially available, Scassero said. Such drones would have to be engine-powered rather than battery-driven. They also would need to have the ability to avoid obstacles and to carry a reliable method of preserving organs.

The university's drone test site managed Scalea's test flights. They started small, flying only 3 miles, the approximate distance between the rooftops of two urban hospitals.

Scalea created the special cardboard cooler and sensors for monitoring the organs in partnership with Maryland Development Center, a medical technology company working with the state's academic inventors. Scassero said the final products and overall system likely will involve myriad groups and companies.

"The doctors have made progress on the medical side, and this is the drone side," Scassero said. "This is the harder part of the equation. ... We're working to show we can do this safely and efficiently."

But the promise is huge. Such flights could avoid airline delays or traffic or even bad weather. Scalea, who has gone to pick up organs in his own vehicle, estimates that drones eventually could reduce travel time by 70 percent on the farthest deliveries.

The flights could avoid mishaps like a recent report of a heart left in a Southwest plane flying from Seattle to Dallas. Hearts are not normally put on commercial flights but only the valves were scheduled for transplant. The airline reported that the plane returned to the airport while the valves were still viable, though passengers were delayed about five hours.

More than 114,000 people are on the national waiting list for an organ, according to UNOS, or the United Network for Organ Sharing, the nonprofit that manages the transplant system. Organs travel farther than in the past—sometimes across the country—and that trend is expected to increase as officials work to make distribution more equitable and reach the sickest patients.

Time already is a big obstacle. About 14 percent of donated organs are discarded, partially because of reduced quality. Kidneys are by far the most transplanted organ, and about 20 percent are not used.

Kidneys can endure the longest time on ice, called cold ischemia, and can cross the country to a recipient on a commercial flight, according to UNOS. Hearts and lungs last four to six hours, and livers only a bit longer, and all those typically travel by charter. A hand or face can wait no more than a couple of hours.

Dr. David Klassen, chief medical officer for UNOS, said computer programs do the matching and factor time among other parameters. He said drones could mean better matching and less waste. They also could contribute to more equitable allocation by directing organs to the sickest patients, something the agency has sought to address amid criticism, court challenges and research showing a tendency to limit organs' distribution by geography.

"One thing that confounds us is getting organs from place to place," he said. "There are limitations on flying organs. ... Drones could address some of the issues. It's an intriguing idea. It won't be simple."

Klassen said he believes the public would be more accepting of drones buzzing overhead for life-saving purposes, much like medevac helicopters, than for deliveries from companies such as Amazon. The giant online retailer has floated the idea of parachuting orders from

drones into people's yards.

Questions about drone delivery from regulators, as well as the public, likely would focus on public safety and organ quality, Klassen said.

There are also technical issues, he said. While organs are normally infused with cold fluids and packed on ice, new technology keeps organs warm and actually functioning outside the body with the aid of machines. Those still might require human escort for now.

Maryland records more than 100,000 deliveries of organs and tissues a year, said Charles Alexander, CEO of the Living Legacy Foundation, which manages transplants for most of Maryland.

Errors like the Southwest delivery are rare, he said. But officials often face difficulties because pilots that fly charter flights don't always work at night when organs become available. Sometimes, organ removal from donors is delayed to preserve the transplant window.

"Transportation logistics are the greatest challenge in our field," Alexander said, adding that the challenge will only grow as organs travel farther to recipients.

"This is being done with this philosophy of broader sharing," he said. "Drones are absolutely worth exploring, but there are hurdles."

Doctors and engineers at the university hospital and elsewhere in the state continue to work on aspects of those hurdles.

A team at Johns Hopkins University has been working on special coolers that could safely transport medical supplies such as blood, vaccines and other medications over long distances. The coolers have transported blood samples the farthest in the United States, across 161 miles of

Arizona desert over three hours, and found no problems. Separately, engineers at the University of Maryland, Baltimore County continue to work with Hopkins doctors on a special monitoring system that senses when organs are fading and compensates by automatically tweaking the makeup of the surrounding solution.

Scalea devised his own monitoring system that can send real-time information on the condition of an organ to a transplant doctor's cellphone during flight. The sensors fit inside a wrap like a beer koozie along with the organs.

Any final delivery system would likely rely on a range of technologies to transport organs and other medical supplies.

There likely will be plenty of demand. Hospitals such as the University of Maryland Shore Regional Health on the Eastern Shore, which serves a wide area, tested [drone](#) delivery of medications across the Chesapeake Bay in 2016. And groups including Doctors Without Borders, the nonprofit service organization, have been testing drones to deliver lab specimens collected from rural areas overseas.

Stefano Di Carlo, the Tokyo-based head of operation support for the doctors relief group, said officials would like to move larger cargo farther. People in war zones likely would be wary because drones are also used as weapons, but poor areas lacking in infrastructure would be among the places most eager for such delivery.

"If the technology become cheaper, more reliable and easier to set up," Di Carlo said, "the potential is huge."

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