

WINFOCUS brings space station ultrasound from orbit to the ends of the Earth

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NASA astronaut Tom Marshburn assists Canadian Space Agency astronaut Chris Hadfield, with an Ultrasound 2 scan in the Columbus Module of the International Space Station. Credit: NASA

Fast, efficient and readily available medical attention is key to survival in a health emergency. When a person is stricken with injury or illness, getting a quick and accurate diagnosis through medical imaging technology can be crucial for ensuring proper treatment. For people who live in major cities and towns where fully-equipped hospitals are only a quick ambulance ride away, that's not usually a problem. But for those without medical facilities within easy reach, it can mean the difference between life and death.

For astronauts in orbit about 240 miles above Earth aboard the International Space Station, that problem was addressed through the Advanced Diagnostic Ultrasound in Microgravity (ADUM)

investigation. Station crew members trained to use a small ultrasound unit aboard the station to examine fellow crewmates. In the event of a health concern, astronauts could use this facility to diagnose many injuries and illnesses with the help of doctors on Earth. Last year, the ultrasound unit used for ADUM was replaced with a smaller and even more sophisticated scanner dubbed Ultrasound 2, currently in use aboard the orbiting laboratory.

Now those same techniques are being adapted and used for people living in remote, underdeveloped areas far from any hospital, where CT scans, MRIs and even simple X-ray exams are impossible. In partnership with the World Interactive Network Focused on Critical Ultrasound (WINFOCUS), ADUM principal investigator Dr. Scott Dulchavsky is taking techniques originally developed for space station astronauts and adapting them for use in Earth's farthest corners.

"The ADUM experiment developed protocols for performing complex procedures rapidly with remote expert guidance," said Dulchavsky. "The procedure was streamed live to allow doctors to request adjustments to the exam real-time. We did about 80 hours of [ultrasound exams](#) on the space station, and it worked pretty famously. After some modification of the process, we got a pretty slick product."



This is a view of the screen during a tele-ultrasound guidance session performed by a WINFOCUS doctor in Italy to a team in rural Brazil. Credit: WINFOCUS

Although the experiment worked on the space station, Dulchavsky was looking to further the reach of this valuable tool. "I'm a doctor on Earth way more than I'm a space medicine doctor, so I was trying to figure out how we could transition this work to care for people on the planet, particularly in remote, austere, underserved environments," Dulchavsky explained. He already had adapted ADUM protocols for Earth-bound use by non-medical professionals, such as athletic trainers of several pro sports teams and Olympic athletes, but he knew that much more was possible. Enter WINFOCUS.

"Ninety-five percent of the population doesn't have quick access to some of the most common diagnostic tools doctors use," said Dulchavsky. "WINFOCUS is a global network organization, and their main goal is to use ultrasound as an enabling point-of-care device." In their effort to make medical care more accessible in remote regions, WINFOCUS already had been developing training methods for physicians and other personnel, sometimes termed "physician extenders," faced with the diagnosis and treatment of disease and injury in places lacking modern medical resources.

"We started working with Dr. Dulchavsky in 2006 and more extensively since 2010, when I joined Henry Ford Hospital to build international healthcare development programs in association with WINFOCUS," says Alberta M.C. Spreafico, WINFOCUS outreach and human development programs coordinator. "WINFOCUS develops and updates its educational material and tele-ultrasound—used to train medical personnel worldwide—also in cooperation with Dr. Dulchavsky and integrates some of the techniques and innovations developed in the [space station] ADUM project."

As it happened, the protocols and methods of ADUM were just the thing to link the frontiers of orbital space with the remotest regions on Earth. Using the ADUM methods, WINFOCUS has trained over 20,000

physicians and physician extenders in 68 countries. Spreafico states, for example, "We used the ADUM project in two important holistic healthcare projects: in remote areas of Nicaragua (from 2011) and in Brazil in a state-wide healthcare project in partnership with the Secretary of Health of the State of Minas Gerais (since 2012)."

More generally, Spreafico notes, "The ADUM techniques have been effective educational tools, especially for the abdominal and musculo-skeletal modules. WINFOCUS has also benefited from the tele-medicine and remote guidance techniques developed during the [space station] research project. WINFOCUS then adapted and further developed them in order to allow large-scale integration in healthcare systems on Earth through low-cost applications. Local healthcare providers are empowered, more patients can access quality and timely diagnostic care, and the entire healthcare system is made more accessible and efficient."

ADUM's impact is also felt in modern emergency rooms, proving the effectiveness of ultrasound in diagnosing conditions previously considered beyond its technical capabilities, such as a collapsed lung. "When we were proving that it worked on the ground, we found out that it's not only as good as what we were doing, it's a little better than getting an X-ray," said Dulchavsky. "And it's way quicker. So now it's become a standard for care. If you go into virtually any ER in the U.S. and probably Canada as well, and they're worrying about a collapsed lung, they're going to do an ultrasound on you, and they're probably going to be able to affect your care quicker."

In fact, the ADUM protocols have proven so effective that they're now part of the standard medical school curriculum. "We came up with a pretty slick way of having a multimedia, interactive easy-to-use point-of-care tool that rapidly teaches you something quickly in a really targeted fashion. So if you are in one of the 10 or so medical schools in the country that now teaches point-of-care ultrasound, you are using our

stuff." The American College of Surgeons, which requires ultrasound training for all surgical interns and residents, is also using the ADUM program. "We developed the program that now 100 percent of surgeons use in the U.S.," said Dulchavsky.

The ADUM investigation and the WINFOCUS partnership have brought the promise of [space station](#) research back down to Earth in perhaps the most direct and immediate way possible – keeping people healthy and alive. As far as Dulchavsky is concerned, that's always been his main priority as a physician. "My big push is, okay, great, it works fine to take care of the six folks in orbit or going to Mars, but how can we bring this back for the greatest possible impact on Earth? I always have that in the back of my head. And I think we've been pretty successful so far with utilizing these techniques."

Provided by NASA/Johnson Space Center

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