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## Application - Revolutionary Telemedicine Techniques Lydia Dotto reports on Long-Distance Surgery

### Long-distance surgery - by Lydia Dotto

The patient is on the operating table, but the medical specialist is not only outside the room, he is in another city. LYDIA DOTTO tells how robots and teleconferencing might solve some of our health-care problems

When people talk about reducing surgery waiting lists, robots and video cameras generally don't enter the conversation -- unless you're talking to Mehran Anvari. Dr. Anvari, director of the Centre for Minimal Access Surgery (CMAS) at St. Joseph's Hospital in Hamilton, believes new surgical robots and advanced videoconferencing can revolutionize health-care delivery in Canada, especially in small or isolated communities lacking access to specialized surgery.



**Minimal Access Training - St. Joseph's Hospital**

These technologies may also provide people in remote, hostile environments, such as polar regions, war zones or the international space station, with life-saving emergency care even if no doctor is available. This application will be tested this month in an underwater mission run for NASA and the Canadian Space Agency.

Known as "telementoring" and "telesurgery," the techniques allow an expert surgeon to observe and assist in operations remotely and perform hands-on procedures using robotic arms.

Dr. Anvari, an expert in laparoscopic surgery, has collaborated on 22 operations with Craig McKinley, a laparoscopic surgeon based in North Bay, Ont., who is also a member of CMAS. They included heartburn surgeries on the esophagus and stomach and colon and bowel resections in cancer patients.

Dr. Anvari received funding from the federal and provincial governments to test the ability of robots to "provide the hands and eyes of the expert surgeon" in a remote operating room.

Laparoscopic surgery, also known as "keyhole" surgery, involves making small incisions through which a tiny video camera and surgical instruments are inserted. Patients experience less pain and recover faster than with conventional surgery, which requires large cuts.

Dr. McKinley said laparoscopic surgery is uniquely suited to telementoring and telesurgery. "When we operate, we look at the picture that comes from the camera; that's what we use to guide our instruments and perform our surgery. That video stream can be sent anywhere. That's the only visual feedback, whether you're standing in the room or standing halfway across the world."

Dr. Anvari said CMAS is the only medical centre in the world doing remote laparoscopic surgery.

In his control room in Hamilton, he watched video coming from Dr. McKinley's operating room via fibre-optic links and used joysticks to control the two-armed robot that operated on the patients in North Bay. This is challenging because, even with high-speed communications, there is a small delay between the joystick movements and the robot's response.



**Robotic Assisted Minimal Access Surgery**

Dr. Anvari said CMAS is working to develop computer software, similar to that used in video games, to predict the robot's movement so that the surgeon does not have to wait for its response. One day, robots may also have a sense of touch that would allow remote surgeons to actually feel things, such as how hard they are pulling while sewing sutures or how strong tissues are.



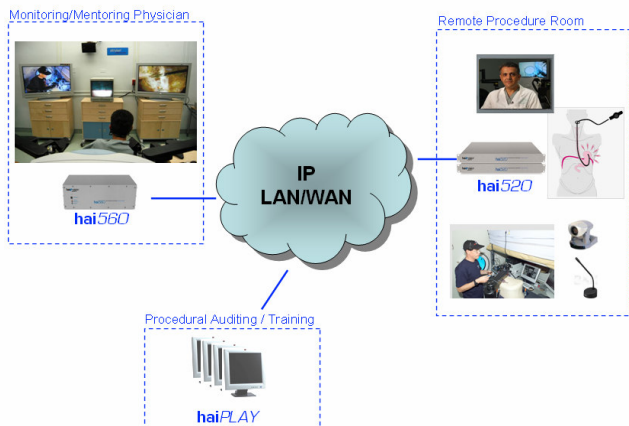
**Tele-Robotic Surgery at CMAS**

The operations in North Bay proved that a surgeon can do the entire procedure from a distance, Dr. Anvari said. "Half of those operations, I did from here; in the other half, I assisted the local surgeon. But the aim was to allow the local surgeon to do most of it, with the expert assisting him and being able to step in only when necessary."

Anvari said. "We've been investing in transferring patients to the big hospitals to receive the latest surgeries. The result is that waiting lists have grown. If those patients can receive their care locally, waiting lists could come down substantially."

He said these techniques would improve the quality of care in small communities and also encourage doctors to work there and to stay in Canada. "We may be able to recruit and retain more specialists in these communities."

Dr. Anvari has trained many surgeons who went to the United

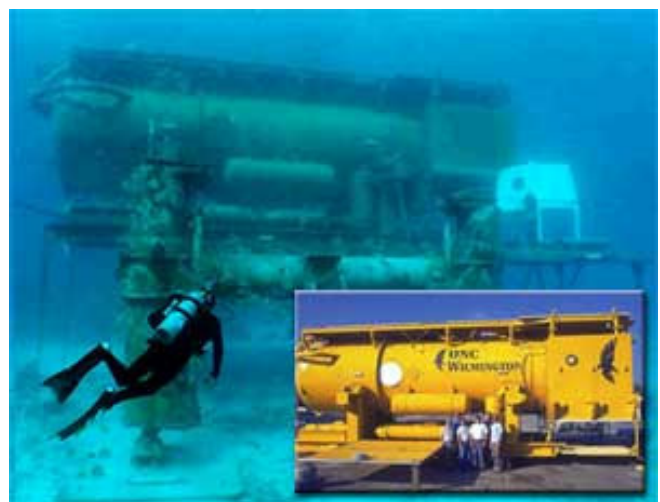


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Dr. McKinley added, "We exchanged tasks seamlessly and effortlessly. We demonstrated that two surgeons can collaborate very efficiently and operative tasks can be flipped back and forth."

Dr. Anvari noted that the patients were pleased because they could have their operation locally and stay close to their families, yet still have access to the expertise of specialists and advanced procedures available in larger hospitals.

By decreasing the need to transport patients to larger centres, costs, waiting lists and patient stress can be reduced, Dr.



**Aquarius Underwater Lab for NEEMO Missions**

States rather than working in small hospitals in Canada. "We train somebody to do all sorts of exciting operations; if they're going somewhere where they're only going to do the most minor surgeries, it's not as alluring as it could be."

Telementoring and telesurgery may also be useful in remote locations where there may not be a surgeon or even a doctor.

Dr. Anvari and Dr. McKinley are participating in NEEMO 7, a 10-day underwater mission, scheduled to start on Oct. 11. It will be commanded by Canadian astronaut Dave Williams, a doctor who once ran emergency services at Sunnybrook Hospital in Toronto. He served four years as head of NASA's life sciences program and is keenly interested in finding ways to deliver advanced medical care in space.



**Sick Bay**

In the Aquarius lab, 19 metres deep in the Florida Keys, Dr. Williams and Dr. McKinley, along with NASA astronauts Michael Barrett (also a medical doctor) and Catherine Coleman, will perform diagnostic tests and surgical procedures under the guidance of Dr. Anvari, who will observe and advise them from his lab in Hamilton almost 2,500 kilometres away.

As principal investigator, Dr. Anvari is aiming to determine whether he can "train a non-surgeon or a non-physician on the spot, as necessary."

The crew members, including the non-physician astronaut, will take standard diagnostic ultrasound images of each other. They will also take ultrasound images of organs inside a simulator that resembles the human abdomen, which is used to train doctors on laparoscopic techniques. They will use the ultrasound to identify and drain an abscess. They will also use laparoscopic techniques on the simulator to find and extract a kidney stone.



**Live Feedback of Sick Bay to Remote Physician**

The goal is to compare the capabilities of the physicians -- only one of whom is an experienced laparoscopic surgeon -- as well as those of the non-physician.



**Astronaut Tele-Surgical Training**

12

These are "fairly complex procedures" normally done by specialists, Dr. Williams said. "We're talking about people who literally have never done this before. What level of paramedical training do you have to have? Nobody knows the answer -- that's what we want to learn."

Although there are a number of physician-astronauts, not all space crews have one -- and even when they do, these doctors are not experts in every procedure. So the question is, can physicians who are not surgical specialists -- and astronauts who are not even doctors -- perform advanced emergency procedures in space with the help of ground-based experts?

This question applies equally to situations on Earth where people live and work in remote, hazardous environments. There have already been several risky missions to remove people from Antarctic research stations for medical reasons that might have been avoided by using telesurgery. "Rather than having people risk their lives in the middle of winter to med-evac patients out -- and in situations where that can't happen -- this type of technology may be useful in providing care," Dr. McKinley said.

The battlefield is a similar case, Dr. Anvari said. "Can you stabilize your patient so you can save lives or limbs before they get to somewhere where they can get adequate care?"

MD Robotics, the company that built the Canadarms for the space shuttle and the space station, is also building medical robots and is discussing the potential of battlefield telerobotic surgery with the U.S. military.

These technologies could also be a boon to Canada's remote northern communities. Many are served only by nursing stations and lack even family doctors, much less specialists. Dr. Anvari said there's only one part-time surgeon serving Nunavut.

"There are places that have no access to physicians unless they fly their patients out, sometimes hundreds or thousands of miles. The technology we're testing in NEEMO will have significant applications for this country and other countries."



### Common Problem – Urinary Tract Blockage

Dr. Anvari said it might even be possible to telementor people with no medical training at all to provide emergency care in life-threatening situations.

For example, someone with brain swelling from a head injury may need immediate treatment to relieve the pressure.

"Can you train somebody to do a burr hole? Yes, you can. It's not a major thing and it will save that person's life." An inexperienced person would "probably be squeamish," he said, "but if you've got somebody's life in your hands, you will do it."

Dr. Anvari is waiting to hear if the federal and provincial governments will provide funding to continue the telementoring/telesurgery project.

Dr. McKinley argues that these technologies are as revolutionary as printing and the Internet in their ability to spread knowledge and skill. They allowed him to expand the repertoire of surgical procedures he can offer his patients and they can do the same for doctors everywhere. They can bring an expert surgeon "into any operating room in Ontario, in Canada, in this world or even outside of this world," he said.

Lydia Dotto is a freelance science writer.

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### Astronaut Tele-Mentoring Training

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