Telesurgery: Live, Remote Collaboration and How it Benefits Hospitals

Educational Content from the TIMS Medical “Telemedicine Reimagined” Series
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As I foreshadowed in my earlier article (“Telemedicine: Much More than Doctor-Patient Video Visits”) the range of applications for real-time, high quality video in hospital settings are vast.

In this article (#2 in the Reimagining Telemedicine series), I will examine the origins, present state, and proven benefits of Telesurgery – which I consider the most compelling application of telemedicine.
The importance of looking inside the body for medicine

Beyond authoring the oath that bears his name, and as the acknowledged “father of medicine” -- Hippocrates could also dubbed “the inventor of endoscopy.” Among his many contributions to modern healing, Hippocrates was the first scientist to suggest that looking inside the body was essential to diagnosing the source of disease and illness.

While it’s unlikely that Hippocrates could imagine the capabilities of present-day medical imaging technology, he would marvel at the effectiveness of endoscopic procedures in gastrointestinal and reproductive systems, to say nothing of their use in complex surgeries.

Medical professionals have been able to look inside a body (at the patient point of care) since the last decade of the 19th century, when Dr. John Macintyre (Scottish engineer turned physician) developed and used the first self-illuminated endoscope for an internal investigation of the larynx.

In 1897, just two years after W.C. Röntgen produced the first X-Ray images, Macintyre presented at the first meeting of what is now the British Institute of Radiology (BIR).

At that conference, Dr. Macintyre showed delegates what he described as the “First XRay Cinematograph Film ever taken.” That film is the world’s first radiological video, showing in 58 seconds a complete cycle of the human heart, as well as the movement of leg joints and digestive organs.
Telesurgery - Taking Surgery Beyond the Operating Room

In the 100+ years since Macintyre’s initial public demonstration, the capabilities for subdural radiological imaging and medical video have increased in leaps and bounds.

Leveraging technologies (such as MRI, CT, PET and SPECT scanners; ultrasound and fluoroscopy), widespread access to real-time medical imaging now allow literal and figurative insights into patients’ conditions. Beyond those applications, the combination of high quality real-time medical video with secure broadband internet connectivity has enabled another major advance in medicine: Telesurgery.

Also known as remote surgery, Telesurgery is defined by Wikipedia as “the ability for a doctor to perform surgery on a patient even though they are not physically in the same location.” The word “telesurgery” is derived from two Greek words “tele” (meaning “far off”), and “cheirourgia” (meaning “working by hand.”)

A May 2018 paper published by Cureus on the NIH.gov website describes telesurgery in its introduction:

“Telesurgery is an emerging surgical system that utilizes wireless networking and robotic technology to allow surgeons to operate on patients who are distantly located. This technology not only benefits today’s shortage of surgeons, but it also eliminates geographical barriers that prevent timely and high-quality surgical intervention, financial burden, complications, and often risky long-distance travel. The system also provides improved surgical accuracy and ensures the safety of surgeons.”

Directed by Dr. Jacques Marescaux (now director of the European Institute of Telesurgery), the first complete remote surgery (removal of a gallbladder of a 68 year old woman) occurred with the patient and surgical system located in an operating room in Strasbourg, France, while the surgeon and remote console were situated some 4,300 miles across the Atlantic Ocean in New York City.

Since then, advances in the availability of surgical robots and fast/reliable internet networks have increasingly made possible capabilities for telementoring, teleproctoring, and telesurgery across a range of medical specialties (including urology, neurology, oncology, and cardiology).
Telesurgery in Urology

Among those specialties, urology stands out as one that particularly benefits from telemedicine. As the tenth most common type of cancer worldwide, bladder cancer is described in *The Journal of Telemedicine and Telecare* as “the most costly malignancy to manage per capita due to the technical nature and intensity of follow-up.” This is because “there are few urologists in rural areas, often necessitating that patients travel hours to receive follow-up care multiple times per year.” To address this challenge, innovative hospitals are increasingly training nurses and staff to perform diagnostic cystoscopies whenever and wherever convenient for the patient, while cystoscopic video is then shared, monitored, and interpreted in real-time by board-certified urologists.

A notable pioneer in urologic telesurgery is Dr. Eugene Y. Rhee, MD, MBA, Regional Chief of Urology for Kaiser Permanente Southern California, the largest managed healthcare organization in the United States (with 11.8 million members). Building on proven positive results with telecystoscopy, in 2016, Dr. Rhee and his colleagues launched a Kaiser Permanente telesurgery pilot program. Collaborating closely with our company (TIMS Medical), Kaiser has since expanded beyond the initial installation, in order to create what Rhee describes as a “true telesurgical operating room with real-time ability to jointly perform any procedure remotely as a ‘virtual assistant’.”

In a 2016 paper on “Telemedicine in Urology” (published by the *American Urological Association*) Dr. Rhee (and co-authors Matthew Gettman and Aaron Spitz) described the function and benefit of this novel telesurgery application, writing that it is “performed by viewing a video monitor in both places with the simultaneous ability to tele-illustrate for purposes of precise surgical supervision.”

In the paper Rhee et. al. favorably described urologic telesurgery as a “type of innovative thinking and new approach to old problems.”
Cardiac Telesurgery at Boston Children’s Hospital

For more than 150 years, Boston Children’s Hospital has been recognized as a world-class innovator in pediatric clinical care, research, as well as serving as primary pediatric teaching hospital for Harvard Medical School. Ranked #1 U.S. children’s hospital for the last six years in a row, Boston Children’s treats more kids with rare diseases and complex conditions than any other hospital.

Among its litany of medical services and programs, the Department of Cardiac Surgery at Boston Children’s Hospital has been at the forefront of pediatric heart surgery since 1938, when Robert Gross, MD performed the first operation to correct a congenital heart defect. In the years since that groundbreaking procedure, the BCH Department of Cardiac Surgery has grown to become the largest in the United States and one of the most specialized in the world.

The department’s Surgeons, Perfusionists, and support staff are a highly effective team that operate on children that are deemed too complex for other heart centers, while still achieving some of the best success rates in the world.

Leading the 10-person BCH surgical team is Pedro J. del Nido, MD -- Chairman, Department of Cardiovascular Surgery at Boston Children’s Hospital, and William E. Ladd Professor of Child Surgery, Harvard Medical School.

Dr. del Nido is well known as a pioneer of new applications for minimally invasive cardiac surgery for pediatric patients. Through the use of new imaging, instrumentation, and robotics technologies, BCH is advancing new telesurgery techniques (such as reducing the use of cardiopulmonary bypass and minimizing incision size in order to reduce trauma and complications associated with surgery.)
A central component of the telemedicine practice at Boston Children’s Hospital is its **TIMS Consultant** system – a platform for real-time video and audio collaboration during surgeries and diagnostic procedures. Using **TIMS Consultant**, cardiac surgeons in operating theaters at BCH wear advanced head cameras with ancillary lamps to capture/share a live feed of high-resolution video (with limited lag time) of the patient’s chest cavity.

As only a limited number of people can fit into an Operating Room – streamed video via the TIMS Consultant platform is then securely shared directly from the operating table to others in remote locations including:

- Offices of other BCH colleagues/cardiac specialists
- Remote advisors (including cardiac surgeons at other children’s’ hospitals)

This advanced video and audio system creates a helpful communications connection commonly known as **“Telementoring”** which allows the local surgeon to be mentored by a more expert surgeon (located anywhere in the world).

For optimum patient outcomes, TIMS Consultant also supports **“Telestration”** - a technique that allows a remote surgeon to use an electronic drawing tablet (e.g. computer screen or iPad) to make illustrative marks on the local surgeon’s video monitor. Thus, both local and remote surgeons share the same view through telestration: helping participants highlight anatomical anomalies, or pinpoint where to make an incision. Additionally, video and audio from surgical sessions can be recorded and played back immediately, or at another time for these purposes:

- Compliance and documentation
- Program sharing at medical conferences
- Distribution to medical school students for distance learning and on-demand curricula

Through its affiliation with **Harvard Medical School**, the Boston Children’s telehealth system is also being used to enable Residents and Fellows to create 3D models of heart images incorporating CT and MRI scans. Surgeons have found that advanced imaging systems working in concert with robotic arms, wrists, and other precision instruments, along with haptic feedback technologies (for a crucial sense of touch), enable complex extracardiac and intracardiac procedures to be performed. “Novel Surgical Approaches” like robotics and enhanced visualization practiced at BCH were out as 1-of-5 “high priority recommendations” in a 2005 report from the **National Heart, Lung, and Blood Institute’s (NHLBI) Working Group on Future Directions in Cardiac Surgery.**
Telesurgery—Enlightening a Brighter Future for Medicine

As demonstrated in the use cases at both Kaiser Permanente and Boston Children’s Hospital, the practice of telesurgery yields numerous and significant benefits for multiple parties in the surgical experience (hospitals, surgeons, patients and families). Here’s a list of 12 of those benefits…

12 Benefits of Telesurgery for Hospitals:

By eliminating barriers caused by time and place, Telesurgery improves access to medical expertise and delivers these twelve benefits:

1. Enables surgeons located in different facilities to engage and collaborate in real time
2. Facilitates just-in-time telementoring between one or more experts during technically challenging procedures
3. Allows high-definition live medical video to be shared simultaneously with multiple medical professionals
4. Video supports the roll-out of new procedures by broadcasting an expert performing and narrating the new procedure to colleagues based in different locations (within a healthcare provider’s network of care centers).
5. Through telementoring: accelerates learning for medical students in training, and in assisting and training new surgeons (seeing is believing)
6. Residents and fellows can experience many more live clinical encounters than they would via typical legacy programs (which limit access)
7. Better patient outcomes through access to superior surgical teams; minimization of medical errors, complications, tissue injury, and post-op trauma
8. Reduces need for long-distance travel (for both patients and physicians), along with travel-associated costs and potential dangers (e.g. delays)
9. Connects hospitals in underserved rural communities with more experienced medical specialists in well-equipped hospitals in urban locations
10. Minimizes medical professionals’ exposure to radiation and viruses via remote participation
11. Cost of Care reductions through new operational efficiencies and faster patient discharges
12. Video recording provides documentation and compliance to protect against malpractice risks and fraud

NOTE: The dozen examples itemized above do not represent a comprehensive list of value delivered to hospitals through the use of telesurgery.

We’d be interested in hearing from others on YOUR personal experiences.
Let us know: What additional benefits of telesurgery have YOU seen?
This original article

“Telesurgery: How Hospitals Benefit from Remote Control”

is the second in a series of educational “Telemedicine Reimagined” articles

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