Surgical Telementoring News

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SPECIALTY SOCIETIES JOIN TO IMPROVE SKILLS

For the first time in the United States, several surgical specialty societies will join together to implement a Grant to determine whether telementoring, otherwise known as "remote presence", can help doctors learn new skills and improve old ones. If successful, this initiative could become the model for the training of mid- career surgeons and medical proceduralists who are not fully familiar with current techniques. They will be able to utilize equipment that allows more accomplished surgeons to watch and participate in their surgery from a remote site, to help less experienced surgeons with real-time advice and instructions.

Currently many laparoscopic surgeons attend 'weekend' courses away from their home institutions to learn new surgical skills on simulators or animals. What if those surgeons could further train in their own institutions while they are operating on their own patients with their own team members? Telementoring would allow just that. With the evolution of technology, telementoring has become feasible and shown promise in the training of some advanced surgical procedures. However, telementoring in advanced laparoscopic bariatric procedures has not been studied pre-

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Surgical Telementoring in Pediatric Minimally Invasive Surgery

Dr. Steven Rothenberg in Colorado and his former fellow Dr. Todd Ponskey in Ohio, recently performed the first ever telementored thoracoscopic lobectomy on a five-month-old female. Because this infant could not travel, telementoring was arranged to perform a right lower lobectomy of a congenital lung lesion. The surgery, performed in less than two hours, was one of the most complex procedures ever telementored. It not only saved a costly and difficult journey, but also ensured the infant the highest level of expertise available. Dr. Rothenberg helped with pre-operative set-up, positioning, trocar placement, and then guided Dr. Ponsky through the case without complication. According to Dr. Rothenberg, "The efficacy of this technique and technology in surgical education is huge".

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GLOBAL TELEMENTORING

Surgical Telementoring using a tablet - bridges two continents

In January 2014, Dr. Conor Delaney and Dr. Knut Magne Augestad at University Hospitals Case Medical Center assisted Dr. Rolv-Ole Lindsetmo at University Hospital North Norway, 6500 miles apart, in the first transatlantic telementored surgical sessions ever performed using a tablet PC. Two patients with colorectal cancer were operated on in Norway, and during the

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Telementoring in endoscopic skull based surgery goes global

The team of Drs. Carl Snyderman, and Paul Gardner are sharing their skills with the medical world in the belief that "In the field of medicine, learning is a life-long pursuit". At the University of Pittsburg Medical Center (UPMC) they have developed a model for global education of surgeons that uses telementoring to bridge the gap between the laboratory and independent

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Telementoring in Urology from Canada to China, Brazil and the US

"Helping to train 250 surgeons in China can translate to better care for 100 million people in Sichuan Province alone. It's an amazing ripple effect." Says Dr. John Denstedt Chair/Chief Department of Surgery Western University. He has been conducting telesurgery education in urology from the Oper-

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From the Editor:

TELEMENTORING TO IMPROVE PATIENT SAFETY

Patients benefit most from expertly-trained physicians who have access to the latest technology, the newest surgical techniques and the most experienced mentors who can then act as consultants. That's a major goal of a new surgical tool called telementoring; the process in which an experienced surgeon can conduct, guide and mentor a second surgeon from a remote location.

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A WORD ON TELE-TERMINOLOGY

The increased capability of wireless technology today, allows for two-way audio/video communication between a patient or surgeon located in a hospital's operating room and another surgeon that may be a mile or several thousand miles away. This promotes collaboration between fully trained surgeons that are seeking guidance from surgeons with special skills and

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TELESURGERY: IS THERE A FUTURE?

By Charles R. Doarn, MBA

How did it all begin? In the late 1980s, research was underway in robotic systems to support unique activities such as space exploration and battlefield medicine. This work was primarily funded by the National Aeronautics and Space Administration (NASA) and the Defense Research

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TELEMENTORING USING GOOGLE GLASS

Using a wearable computer, known as "Google Glass", physicians at the University of Arkansas for Medical Sciences (UAMS) ,Drs Barry Uretsky, Abdul Hakeem, and Christian Assad-Kottner (Fig.1) performed an interventional patent foramen ovale (PFO) closure procedure with the assistance of a congenital heart expert, Dr Eudice Fontenot, of the Arkansas Children's Hospital .Dr. Fontenot, a recognized authority as the telementor,

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viously.' says Dr. Dmitry Oleynikov, Chief of Minimally Invasive Surgery, at the University of Nebraska Medical Center.

Thus a Grant was provided to the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) who will oversee the design and implementation of the project to improve bariatric skills with the collaboration of The American Society for Metabolic and Bariatric Surgery (ASMBS). This is groundbreaking news, because, despite the reports of individual telementored procedures throughout the world over the past several years, this is the first systematic study to examine the collaborative possibilities for organized medicine. The study to improve skills in bariatric surgery being performed by SAGES and ASMBS will be led by Dr. Ninh T. Nguyen, Chief, Division of Gastrointestinal Surgery at the University of California, Irvine Medical Center. On his team as "telementors" will be some of the nation's leading surgeons, including John M. Morton, MD from Stanford, Daniel B. Jones, MD from Beth Israel, Harvard, Daniel Herron, MD from Mount Sinai, NY and Alex Gandsas, MD from AAMC, Annapolis.

The program is funded by a grant from the Foundation for Advanced Medical Education (FAME), a division of the American Medical Foundation for Peer Review and Education. The results of their FAME 2002 grant to five specialty societies showed that the three-step process (didactic, simulation, and preceptoring), was highly effective in teaching new procedures to practicing clinicians. The final step, the preceptor/preceptee relationship is interactive and fundamental to the learning experience. However, such impediments as travel, conflicting schedules and patient or physician postponement often led to cancellations of the necessary planned interactions (www.medicalfoundation.org/publications). Thus this new grant will use telementoring as the third step to minimize these obstacles.

Accordingly, Dr. Nguyen, the Team Leader for the study, believes that "with this grant, we can test if telementoring can be a useful tool to train surgeons on novel surgical approaches as effectively as an in-person teaching session."

The purpose of this grant is to assess the utility of the telementoring program to improve the skills of bariatric surgeons when performing the laparoscopic sleeve gastrectomy procedure. In this study, the trainee will remotely observe the proctor perform at least two laparoscopic sleeve gastrectomy procedures, as the proctor gives instruction on the key areas of the surgery. After these observations, the trainee will perform the sleeve gastrectomies while being observed and guided by a proctor. Subsequently the trainee will perform additional laparoscopic sleeve gastrectomy cases, which will be recorded for blinded review along with completed data outcomes surveys and a post-program questionnaire.

Bariatric surgeons with some experience in sleeve gastrectomy were invited to apply for a scholarship to participate in this performance improvement program. The qualifying surgeon applicants were also required to be credentialed and actively performing sleeve gastrectomy procedures at their institution.

Since the necessity of travel is the major limiting step in the preceptorship or proctoring process, this telementoring program is expected to eliminate the drawbacks of travel and time away from work and family for both the surgeon trainee and the expert surgeon proctor.

One of the challenges to telemedicine in the United States is the requirement that a physician be licensed in the state in which he is practicing and treating patients. While providing education to another physician through becoming involved in direct patient care, a proctor would, by necessity, need State licensing permission to change or alter a procedure. This would be true even for the purposes of teaching and ultimately improving patient safety.

How can this permission be achieved? A few states currently support telemedicine by granting a license. However, these have different purposes and restrictions and, at this time, do not grant telementoring privileges. Many of the states currently have "consultation exceptions", but most do not articulate what that entails except that a licensed in-state physician can request a consultation from a physician in another state. The majority of these consultation exceptions appear broad enough to possibly encompass telementoring, however in a few states they currently may be too narrow.

These permissions may be moving in a positive direction, however, as one state stands alone in clearly articulating the basis for the possibility. Delaware, in 1787 the first State into the Union, has become the first state to recognize the need for continuing surgical education and permits out of state consultation without need for licensure. Their law clearly states that "… Any consultation done for teaching and/or training purposes may include active participation in procedures, whether surgical or otherwise, provided a Delaware licensed physician remains responsible as the surgeon of record…" (1)

While this law does not specifically mention telementoring, Delaware State Division of Professional Regulation Executive Director, Gayle Lynn MacAfee believes " telementoring will provide a huge potential to the citizens of Delaware by offering patients the best medical expertise despite long distances; thus, allowing an opportunity for all physicians in Delaware to gain additional medical education through telementoring."

Robert C. Knittle, Executive Director of the West Virginia Board of Medicine agrees: "the telementoring program offered by the Foundation is educational in its approach in order to enhance and update the specific skill sets and knowledge of a physician which can then be applied within the practice of medicine. I find your program innovative in its approach and a valuable training and educational component to our physicians in West Virginia. I do not find this program in conflict with the Medical Practice Act." (2)

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Five of the fifteen scholarships have been awarded to surgeons in those two states. In other states, some of the scholarships have been awarded to former fellows of the proctors. That may offer a real solution to the complex problem of transition from residency to practice, which many surgeons find daunting and an impediment to patient safety.

The surgeons selected for this program will receive free of charge didactic on-line resources. Utilizing KARL STORZ VisitOR1®, screens (3), these surgeons will then observe expegastric sleeve gastrectomy through a unique telementoring technology with two-way video and audio live communication. After the case observation, the expert surgeon will telementor the trainee for two or more cases

In addition to this project, SAGES has developed a program called "Go Global" As part of that program they will be providing telementoring to bariatric surgeons in South America. Surgical Telementoring News will be following these programs with a full report on its progress in our next issue.

1) The opportunity of telementoring is made possible through the Delaware Board of Medical Licensure and Discipline's Rule 6.0 for Consulting Physicians, allowing consultations to be done telephonically, electronically or in person, provided a Delaware licensed physician remains responsible as the physician of record.

2) "The section of our Medical Practice Act, 30-3-13(d) is applicable to the actual practice of medicine which is defined as the "diagnosis or treatment of, or operation or prescription for, any human disease, pain, injury, deformity or other physical or mental condition. The practice of medicine is patient specific. Consultative practices are perceived as patient specific encounters which at times may even involve direct patient interaction.

3) "The Grant is being generously supported by KARL STORZ Edoscopy America, Inc., providing the remote presence devices VisitOR1®.

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SURGICAL TELEMENTORING IN PEDIATRIC MINIMALLY INVASIVE SURGERY

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Reported results of telementoring are improving surgical practice, education, treatment and postoperative care. Telementoring is described as a "natural fit" in surgery as surgeons are often sparsely geographically distributed, and with a predicted shortage of surgeons, distance education is becoming increasingly important. Recent technological developments have led to a renewed interest in the potential of telemedicine to provide new cost-effective collaborative solutions in surgery.

The rapid evolution of emerging surgical technologies and procedures has necessitated that surgeons rapidly assimilate and train in a varying array of new procedures. Dr. Rothenberg noted that "this has been especially evident in the field of pediatrics and more specifically neonatal minimally invasive surgery. Cases such as thoracoscopic lobectomy, tracheo-esophageal fistula repair, or laparoscopic correction of congenital intestinal lesions are rare and require a high degree of skill and experience to complete".

While there are large numbers of hands-on courses, teaching aids, video files, and mentoring programs developed to try and help surgeons learn and assimilate these techniques, there is a well-recognized distinction between a surgeon taking a training course and/or a mini-fellowship, and successfully applying these techniques in their practices. Having an onsite mentor is often not logistically or economically feasible, especially in a highly specialized field such as pediatric surgery where there are few expert mentors, or the frequency of a specific procedure is rare. When time is of the essence in a case that is emergent or semi-emergent, time restraints often do not allow for a mentor to be brought onsite. The wide use of the internet and the ability to transfer images and audio communication instantaneously is a logical and cost effective solution said Dr. Rothenberg. "We initially used the InTouch RP-7 mobile robot which had already proved itself in telemedicine endeavors where a physician for various reasons could not be onsite, to bring added surgical expertise into the OR"

The RP-7 has been used extensively to allow physicians to monitor patients within the hospital from remote locations as close as the physician's office across the street to other hospitals within the city or region, and has even been used transcontinentally. "With this in mind, he added, it seemed a logical extension to bring the robot into the operating room environment to determine if similar consultation and mentoring could be achieved. A number of cases where the surgical mentor was offsite using a laptop and the RP-7 was in the OR were successfully mentored. This led to the development of another, more appropriate OR solution called VisitOR1®."

This technology is a collaboration between InTouch Health and KARL STORZ Endoscopy where the "brains" of the RP-7 were mounted on a boom mount clamp inside the OR and was directly connected to the video feeds generated in the integrated operative suite (OR1). The remote surgeon while on a laptop, or more recently from a portable tablet such as an iPad, can connect into the OR and directly communicate with the surgeon. The mentoring surgeon can access the room view as well as directly link to the endoscopic view, and can interact with the onsite surgeon via direct visual contact, voice and telestation.

Dr. Rothenberg started a pilot program at the Rocky Mountain Hospital for Children in Denver and a second VisitOR1® was recently installed at Columbia University in the Morgan Stanley Children's Hospital in NY. He has already established an onsite monthly mentoring program at Columbia for complex thoracoscopic and laparoscopic cases which were not emergent, but the placement of VisitOR1® has greatly increased their bandwidth and ability to deal with more emergent cases over 2000 miles away. In his experience, the communication in all cases between the surgeon and mentor flowed well enough to facilitate the procedure. An additional benefit he said was the ability to have a second junior surgeon on a second control station that can monitor, comment on, and learn from the case. They have also accessed and controlled VisitOR1® from New Zealand, Vietnam, and Taiwan; in the last case participating in resident's hands-on animate lab, proving that this technology could be used globally. The greatest benefits to the operating surgeon seemed to be assistance in setting up the surgery (positioning, trocar placement, etc.), identifying the pathology, and discussing how best to approach the case. In general, the Telementor has considered the visualization of the operative field to be good to excellent, and felt that it allowed for mentoring on a level that was equivalent to having been in the room. The direct feed of the laparoscopic view allows the mentoring surgeon to see the same HD view that the onsite surgeons are viewing.

The greatest advantage in pediatric surgery is helping well-trained surgeons to overcome the hurdles of trying to implement the advanced techniques they have learned in cases that are relatively rare without compromising patient care and bringing added surgical expertise into the operating room. There is no question that surgical telementoring offers this opportunity. Sharing of medical expertise will improve outcomes and in the long run, greatly lower costs.

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surgeries the US based team assisted in identifying key anatomical locations and surgical planes for dissection (Figure 1).

A new low cost and innovative telementor solution

"Telementoring on tablet PCs is a fascinating and innovative solution," says Professor Conor Delaney, Chief of the Department of Colorectal Surgery, University Hospitals Case Medical Center in Cleveland. "The fact that we were able to perform transatlantic telestration (drawings over a live videostream) enhanced the mentors teaching capabilities and made it so much easier to reach a common agreement on the key surgical anatomical locations (Figuer 1). The mobility of the technology is also of key importance, as mentors can connect to any Wi-fi or fast HSPA (High speed packet access) 3G-cellphone network, or the new or the new LTE (4G) mobile network. In a busy hospital workday, this is a huge advantage," says Dr. Delaney. In Norway, Dr. Lindsetmo, chief at the Department of Gastrointestinal Surgery, University Hospital North Norway, is in charge of a hospital telementoring network. "At present we aim to connect several local hospitals to a University Hospital. This will contribute to build surgeon-networks that have the potential of helping surgeons out of difficult situations in the operating theatre. As a University Hospital it is our responsibility to utilize available technology to the benefit of the patients. That is what telementoring is about; to improve the quality and safety of the surgery performed wherever the super-specialist must be located ",

Figure 1. Surgical telementoring and telestration with a PC tablet USA-Norway.

Upper left: Telestration on a PC tablet identifying arteria mesenterica inferior. Upper right: Operating surgeons, mentored by US surgeons, using skype headset phones. Lower left: On site telementoring and telestration. Lower right: Telestration during a prostatectomy. (Pictures by Research Fellow Etai Bogen)

Telementoring as an educational tool

To meet the increasing demand for general surgeons, surgical telementoring for educational purposes should be further explored and evaluated," says Dr. Augestad, Research Manager, Department of Research and Innovation at Norwegian National Center of Telemedicine and Department of Gastrointestinal Surgery, University Hospital North Norway. Recently, a meta-analysis supported evidence that trainees can obtain similar clinical results to expert surgeons in laparoscopic colorectal surgery if supervised by an experienced trainer. Two surveys of laparoscopic telementoring, showed no significant difference in conversion, anastomotic leak or mortality compared to on site mentoring. "In the review we performed," says Dr. Augestad, "there was a 5 % complication rate and 5 % conversion rate, which is accordance with others.." In fact there have been reports of decreased operation time of telementoring compared to physical presence. "

"Present understanding of the effects of videoconference technology on surgical practice is limited," says Dr. Knut Magne Augestad. In a recent systematic review, 34 surveys were identified and summarized (1,2). Four hundred and thirty three surgical procedures were reported, with a complication frequency of 5 %. Laparoscopic cholecystectomy, colectomy and endovascular treatment of aortic aneurysm were most common procedures. All surveys focused on education, however only eight (23 %) had a systematic evaluation of surgical performance and educational outcomes and reported improved surgical performance. Perceived usefulness of surgical telementoring was high among 83 % of surgical trainees. But, there was considerable room for improvement of research quality, as only 20 % of papers had defined a clear research question. Similarly, only 30 % of surveys performed an evaluation of user satisfaction of the technological telementor solution.

Telementoring as a tool to meet the surgical shortage

Unless the rate at which general surgeons are trained increases, the number of general surgeons per population will continue to decline This means that the rate and volume of surgical education has to increase, and videoconference and surgical telementoring can be used to meet this demand. Telementoring as a tool for education between different levels of healthcare has been described by different surgical specialties. Participant satisfaction was high and the opportunity to discuss case management significantly improved. However, bringing together multiple experts to focus on a single patient is a logistical challenge. With videoconferencing and telementoring, discussion of a series of patients among a broad range of experts is possible across vast distances.

Telestration, a core function in telementoring

From a clinical perspective, aspects such as video encoding and video resolution in telementoring solutions are important. Video encoding affects, for instance, how nuances in color of the intestines get represented in the video signal. Picture resolution affects what anatomical landmarks may be identified with a high degree of certainty. A video resolution of 768 × 492 and higher is perceived to give high perceived video quality, whereas 320 × 240 and lower is evaluated to provide medium perceived picture quality. The most common telementoring feature is telestration and it seems that this feature is mandatory for all telementoring solutions. The visual assisted mentoring utilizes telestration, which has been used mostly in weather forecasts and broadcasted sport events since the early sixties. Telestrators allow surgeons to draw a freehand sketch over the live video stream, and enables the

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mentors to convey their teaching not only verbally but also visually leaving less place for wrong interpretation of the mentor instructions (3). "In my opinion, telestration is a core function of surgical telementoring, as it enhances the teaching capabilities significantly "says Dr. Lindsetmo at University Hospital North Norway. "I believe that the telestration is an obligatory functionality of telementoring systems due to the increased accuracy of pointing actions. However, no analysis of the impacts of telestration to educational aspects of telementoring has been performed and this needs further attention." (3)

How is the patient security issue met?

All communications within the new telementoring tablet prototype – from the mobile App through telementoring center and to the streamer and back again – are secured over a patent-pending streaming technology using the IETF-standard Transport Layer Security (TLS) protocol, ensuring the confidentiality, integrity and availability of data. The telementoring prototype encrypts all data end-to-end using 256-bit Advanced Encryption Standard (AES). The prototype follows HIPAA guidelines for the privacy and security of remote access to healthcare information and can be used within a larger system to support HIPAA (Figure 2).

An international research initiative is needed

"During the last couple of years the technological solutions for surgical telementoring has made giant leaps forward," says Dr. Knut Magne Augestad. As a research leader at The Norwegian Center of Telemedicine, he has worked with different technological solutions for surgical telementoring. "Two decades ago, we started up with solutions that were costly and extremely difficult for the surgeons to operate. Now we are at a stage where the technological solutions for telementoring are inexpensive and so easy to setup that the surgeons can do this independently. The necessary equipment is a PC, a PC tablet, any voice over IP (VOIP) headsets, telementoring software package, and a reasonably fast Wi-Fi or cell phone connection (Fast 3G/4G)."

"This is a good way to support surgeons in the early stage of their career. More prospective trials are however needed, to further assess the educational outcomes. Recently a national US research initiative was launched. The American Foundation for Peer Review and Education has brought together several specialty surgical societies to determine whether telementoring is an effective way for physician to learn new skills and improve old ones. "The progress of the study is discussed in this newsletter.

Only by joining forces nationally and internationally can we truly demonstrate the potential of such advanced technology. We aim to collect high quality data, universal across surgical specialties, on variables like educational aspects, surgical adverse events, teamwork, organizational aspects and cost effectiveness issues like number of patient travels and mentor travels." says Dr. Augestad. STN

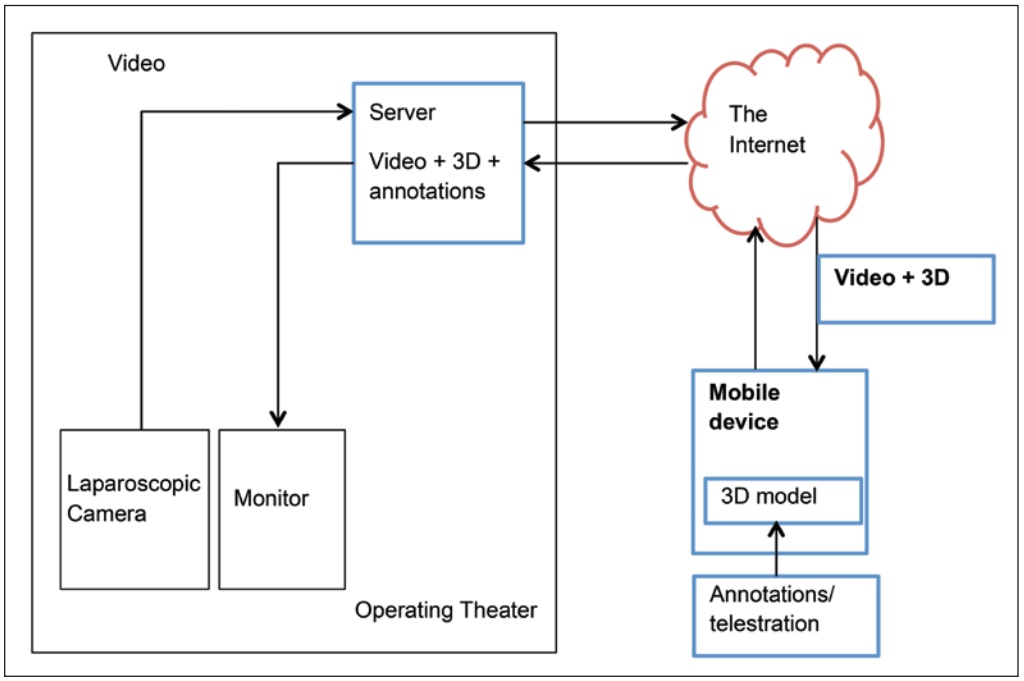

Figure 2. Architecture of a PC tablet surgical telementoring system.

1. Augestad K. Surgical Telementoring in Knowledge Translation—Clinical Outcomes and Educational Benefits: A Comprehensive Review. Surgical Innovation. 2013 Oct 20;20(3):276–84.

2. Augestad KM, Lindsetmo R-O. Overcoming Distance: Video-Conferencing as a Clinical and Educational Tool Among Surgeons. World J Surg. 2009 Apr 22;33(7):1356–65.

3. Budrionis A, Augestad KM, Patel HR, Bellika JG. An Evaluation Framework for Defining the Contributions of Telestration in Surgical Telementoring. Interact J Med Res. 2013;2(2):e14.

TELEMENTORING IN ENDOSCOPIC SKULL BASED SURGERY GOES GLOBAL

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surgical practice., and partnered with the University of Maribor in Maribor, Slovenia to provide telementoring of endoscopic endonasal cranial base surgeries over the last two years (Figure 1). Cranial base surgery is a highly specialized area of surgery that is undergoing a transformation from transcranial to endonasal approaches for many tumor pathologies and locations.

According to the team "The advantages of a surgical telemetering program include training in the actual operating room environment, real-time communication, a shared endoscopic view, telestration capability, and active problem-solving"

There are many challenges for the surgeon transitioning from microscopic to endoscopic endonasal surgery including endoscopic anatomy, instrumentation, 2D visualization, functioning as a team, and dealing with complications. The learning curve is long and there is a high potential for neural and vascular injury. The greatest obstacles to development of a skull base center specializing in endonasal skull base surgery are creating a multidisciplinary team of surgeons and acquiring adequate surgical expertise. The predominant reasons for failure are insufficient volume of cases and lack of mentoring.

The UPMC telementoring model in cranial base surgery has several components: UPMC course and curriculum that includes observation period, on-site visit at telementored site with supervised surgery, remote telementoring, and a follow-up on-site visit. Requirements for telementoring include a skull base team with basic endoscopic surgical skills, adequate resources, and the potential to become a Center of Excellence.

'Tumor types have included pituitary adenoma, schwannoma, meningioma, sinonasal malignancy, chordoma, and esthesioneuroblastoma. Following an initial preoperative consultation about goals and appropriateness of surgery, most of the intraoperative interaction has focused on identification of anatomy, extent of exposure, extent of resection, and surgical technique" they say. According to the team, "telementoring may be accomplished using standard videoconferencing technologies".

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TELEMENTORING IN ENDOSCOPIC SKULL BASED SURGERY GOES GLOBAL

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Although widely available at a low fixed cost, disadvantages include high bandwidth needs, high variable costs, and limited potential for collaboration with real-time interaction. "They have used a conference room dedicated to telemedicine activities for their telementoring sessions. They added "Similar results can be achieved with a PolyCom (San Jose, California) setup. This facilitates two-way communication from any site within the hospital."

But they are currently using a specialized technology for surgical telementoring, the VisitOR1 robot (Karl Storz). "Although the up-front investment was greater, the bandwidth needs are lower, real-time interaction is improved, and variable costs of operation are low. We like the fact that the robot can be accessed by laptop computer with participation by multiple sites." They add that" The unique features of the VisitOR1 robot include simultaneous video feeds from the endoscope and a panoramic camera, and the ability to telestrate and direct a laser pointer."

The team reported that 'The results have been very positive. Perceived benefits noted by the Maribor team include improved exposure, increased extent of tumor resection, and decreased duration of surgery. Overall image quality and transmission has been excellent and there have been no complications in 10 telementored surgeries"

Both Drs. Snyderman and Gardner believe that "Telementoring is an effective way to train surgeons in new or complex surgeries such as endoscopic skull base surgery. Endoscopic procedures are particularly well-suited for telementoring due to the ease of sharing the surgeon's view. Technological advancements allow real-time 2-way communication with insignificant delay. Surgical telementoring may be an effective technique for developing surgical proficiency at remote sites, resulting in Centers of Excellence with promulgation of new techniques. Various business models for remote telementoring need to be explored to determine cost-effectiveness for both institutions.

Figure 1 Drs. Bostjan Lanisnik (Otolaryngology) and Janez Ravnik (Neurosurgery) perform an endoscopic skull base surgery at the University of Maribor in Maribor, Slovenia (A) while Dr. Carl Snyderman mentors the live surgery in Maribor and provides feedback throughout the operation (B).

Center for Cranial Base Surgery,
University of Pittsburgh Medical Center,
200 Lothrop Street, Pittsburgh, PA, 15213,
www.UPMC.com/skullbasesurgery

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TELEMENTORING IN UROLOGY FROM CANADA TO CHINA, BRAZIL AND THE UNITED STATES

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ating Rooms at St. Joseph's Health Care, London, Canada. to a variety of sites in Brazil, China and the United States. Further broadcasts are planned over the course of the next year throughout Latin America and the Middle East.

After 20 years of teaching the next generation of surgeons in London, Dr. John Denstedt is excited about sharing his expertise through the magic of technology, reaching around the world.

He is using the RP Vantage technology produced by InTouch Health, Santa Barbara, California, which allows for two-way communication directly from the Operating Room to surgical learner groups throughout the world. The technology allows for seamless two-way communication between the physician observers and Dr. Denstedt, including views of the surgery both endoscopically and via fluoroscopy. There are two, remotely controlled Pan-Tilt-Zoom cameras and a 9-foot articulating boom, "This has provided us with exceptional detail and coverage." he says, "enabling a dynamic high quality educational experience for surgeons wishing to learn these new techniques and technologies."

Audiences of live broadcasts are provided with several views of the patient and the operating room, and internal views of the surgery itself through a camera scope, giving them a unique opportunity to learn cutting edge techniques.

They can also ask questions during the broadcast, adding to the real time training and collaboration.

As a sought after guest professor, being the author of more than 200 scientific articles and book chapters, in recent months Dr. Denstedt demonstrated two kidney stone removal procedures to 30 surgeons in Sao Paulo Brazil. It involved minimally invasive kidney stone surgery including percutaneous nephrolithotripsy {PCNL} and as additionally ureteroscopy and laser lithotripsy. During PCNL large kidney stones are accessed by a 1 cm incision in the flank area and the central part of the kidney was visualized and stones pulverized and removed with ultrasound. During ureteroscopy a small endoscope was passed up the ureter and stones are fragmented using the holmium: YAG laser. Dr. Denstedt pioneered the use of the holmium laser in 1993 and this technology is now a standard of care throughout the world

Future plans include configuring the system to deliver live surgical educational programs simultaneously to multiple sites throughout the world.

Concurrent to the surgical broadcasts traditional educational media such as lectures, video streaming and power point slide demonstrations have also been incorporated into the curriculum of the existing programs to Latin America and China. Evaluations of the course content and overall impact of the training experience by the learner groups, has been enthusiastically positive. As a next step, his future plans include one on one telementoring for these procedures.

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TELEMENTORING TO IMPROVE PATIENT SAFETY

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Telementoring is a teaching tool that can bring 21st century medical breakthroughs into every operating room, clinic and surgical suite. The philosophy behind telementoring is simple and life-altering – provide the optimal tool for doctors to learn new skills and improve on old ones.

With a Grant by FAME, a division of the American Medical Foundation for Peer Review and Education, several surgical specialty societies have joined together for the first time to pioneer this initiative for the transfer of knowledge and skills from experienced surgical practitioners on complex techniques and procedures.

Telementoring establishes the new model for the most efficient and cost-effective transfer of knowledge and skills ever undertaken from the world's top surgeons to other doctors around the globe, including recent graduates and surgeons who need new training. In this newsletter we described several surgical procedures where mentors have assisted their former fellows in improving skills. This " transference to practice ", is an exciting opportunity for future post graduate physician education This model can create better-trained surgeons, improve medicine, increase patient care, and cut down on the cost and frequency of malpractice cases.

This first edition of Surgical Telementoring News explains telementoring as a surgical tool and introduces some of the people behind it. One contributor, Dr. Knut Augestad, Director of the Department of Telemedicine from the Department of Gastrointestinal Surgery at the University Hospital North Norway, says that "together with the American Medical Foundation and others, we are seeking partners and funding for prospective trials in surgical telementoring. We are especially interested in collecting prospective data from smaller ongoing US and international telementoring trials, in one large quality database across surgical disciplines, where we aim to assess and develop the educational and cost-effectiveness of surgical telementoring"

Please write and tell us about your recent telementoring experience. Only by joining forces nationally and internationally can we truly demonstrate the potential of such advanced technology.

We need your support and would appreciate your comments.

Evelyn Baram-Clothier

Write to :editor@telesurgery.org

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TELESURGERY: IS THERE A FUTURE?

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Projects Agency (DARPA). NASA's primary interest was in the development and utilization of robotics for the U.S. Space Shuttle, International Space Station, and planetary exploration. DARPA was interested in developing tools for application in battlefield medicine, specifically trauma. These research efforts resulted in a wide variety of technologies with some commercialization.

Specifically, this funded research led to the establishment of two companies, Computer Motion and Intuitive Surgical. These companies then developed "telesurgery"-capable robotic "assist" systems, the Zeus and the daVinci, respectively. The term "telesurgery" implied the systems could be used where surgeon and robotic system were separated by, in the daVinci case, a 30 foot cable or in the Zeus case via communications network.

Early rationale for the daVinci-like system was to be utilized on an airframe for wounded warfighters or in the actual theater of war, albeit at the rear echelon. The size of the system was too large and was not deployable, however, SRI was able to successfully license the technology to Intuitive Surgical, and that company has been successful in developing a commercial line of surgical systems sold widely in the U.S. and around the world.

The concept of telesurgery was reflective of a desire to have surgeons in one place and surgical patients in another. This could be attributed to both a need and a potential shortage of surgical care capabilities in remote or extreme environments.

In the early 1990s, laparoscopic surgery began to become more widely used in surgical cases in the U.S. and worldwide. The Zeus and da Vinci systems integrated this minimally invasive surgical (MIS) approach, providing the surgeon a unique position, where they were removed from the actual patient by some relatively short distance.

As the 20th Century came to a close, Computer Motion and Intuitive Surgical were the two companies that had surgical robotic systems on the market. In the early part of the 21st Century, they were merged into one company, Intuitive Surgical.

World's First Telerobotic Surgical Cases

In September 2002, Professor Jacques Marescaux utilized a Zeus robotic system to operate on a patient in Strasbourg, France. Marescaux was in New York City over 5,000 miles away. This surgery, a cholesectomy, was the first true "telesurgery" and has been known as 'Operation Lindbergh'. Marescaux and his team were connected via significant virtual private network (VPN) to the surgical team and patient in France. Using the Zeus 'surgeon' unit, he controlled the patient-sided (surgical arms) with end effectors inserted in the patient. This surgical procedure was successful.1,2

Shortly after this, Dr. Mehran Anvari, a Canadian surgery began to conduct a series of surgical procedures between Hamilton and North Bay. This series of surgical events were also conducted using the Zeus system. Anvari conducted a number of clinical cases with a geographic separation of surgeon and patient.3,4

The outcome of both Marescaux and Anvari's work has been well published and has served as the foundation for most of the research that has followed. Not only can these events lead to new and novel surgical capabilities but they also reinforce the concept of telementoring. Whereby and remote expert can provide guidance to someone who is located in some distance away.

In the mid to late 1990s, NASA funded the development of a commercial space center (CSC) at Yale University within, interestingly enough, the Department of Surgery, under the direction of Dr. Ronald Merrell. On his staff were two recognizable and notable surgeons, Dr. Richard Satava and Dr. James 'Butch' Rosser. The purpose of the CSC, known as the Medical Informatics and Technology Applications (MITA) was to explore and develop testbeds in support of NASA's interest in telemedicine both for human spaceflight and its international activities. Merrell and colleagues had become quite adept at providing surgical capability in mobile facilities in the jungles of Ecuador with low bandwidth connectivity to Yale surgeons for mentoring.5 This concept also proved valuable in mentoring physicians and other providers on Mt. Everest Base Camp.6

A Snippet About Research Efforts to Date

This serves as a testimony of what has been done, and how these possibilities can lead to new and more robust technologies, procedures and opportunities.

As commercial surgical robotic systems were becoming widely available in the early 2000s, one system was capable of long distant operation and the other required additional software modifications to permit such operations. The U.S. Army's Telemedicine and Advanced Technology Research Center (TATRC) began to expand its research portfolio in telesurgery. In 2005, TATRC partnered with the University of Cincinnati's Department of Surgery, Johns Hopkins University, Walter Reed Army Medical Center, and Intuitive Surgical to conduct a series of tests with the da Vinci 'Classic'. The University of Cincinnati (UC) had two systems, one for research and one for clinical case load. The research system was modified to permit remote operations. On two occasions, once from Cincinnati and once from the American Telemedicine Association (ATA) Annual Scientific Meeting in Denver, CO (2005),

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A WORD ON TELE-TERMINOLOGY

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experience in the use of a certain device or performing a particular procedure.

Using various types of equipment such as InTouch's RP-Vantage and KARL STORZ's VisitOR1, hospitals and other organizations are able to facilitate remote procedure observation and a variety of supportive activities with the goal of improving knowledge and clinical outcomes as well as accelerating adoption of innovative medical devices and procedures.

In this first issue of Surgical Telementoring News, Greg Drutchas and Keith Wright, expert attorneys in telemedicine, address terminology for the different uses of remote presence in credentialing, peer review and practice settings. In the next issue, they will review the use of remote presence in enhanced credentialing and peer review.

According to this legal team, "As there is no "industry standard" with regard to terminology and without claiming these definitions represent authoritative nomenclature, we have developed the following terms for our legal work in the area, to describe and distinguish the level of observation and participation surgeons may have in the delivery of patient care by remote presence. In presenting the definitions, we use the term "surgeon" in its broadest sense to include any kind of proceduralist, including, by way of example, cardiologists and gastroenterologists." (1) They present the following categories:

Teleobserver: A Teleobserver is a less experienced surgeon (but could also be a student or other trainee) seeking education by concurrently observing an experienced surgeon performing a procedure or demonstration of the use of a device. The less experienced observer will be able to remotely login and view the procedure, interact in the form of questions to the onsite surgeon. The onsite surgeon is able to teach. Without that interaction, the presentation would be easily substituted by a prerecorded event on videotape or electronic disk. The goal of this process is to expand knowledge and, in appropriate circumstances, spur innovation.

Teleproctor: A teleproctor is an experienced surgeon who, through virtual presence in an operating room, passively observes an onsite surgeon who is perceived to be fully qualified and trained to independently perform the proctored procedures or use of a device. Like a physically present proctor, the teleproctor's interactivity will be limited to the ability to ask questions of the onsite surgeon for clarification. After observation, the teleproctor can then validate the skills of the surgeon or identify potential inadequacies. Examples may be observation on behalf of a hospital medical staff to evaluate a new surgeon who is provisionally appointed, or a current staff surgeon whose skills have been questioned. This approach is also ideal for evaluative use in a hospital lacking a cadre of other unbiased physicians with the same privileges, or for recertification by a specialty organization. In this scenario, the teleproctor does not participate in the procedure, give guidance or otherwise function interactively; rather the teleproctor furnishes a retrospective review to the individual or organization for which the procedure is performed.

Telementor: A telementor is an experienced surgeon, highly skilled in a particular procedure or use of a device, who, on a remote basis, serves as a resource for an onsite surgeon, already fully trained in his field but may or not be fully trained in performing a particular procedure or using a particular device. However, the term telementor can be further broken down into either "Telementor-Advisor" or "Telementor-Preceptor" based on the amount of interactivity the telementor may have relating to the level of intervention in patient care during the procedure or use of the device.

Telementor-Advisor: A telementor-advisor is an experienced surgeon, highly skilled in a particular procedure or use of a device, who, on a remote basis, serves as a resource for an onsite surgeon, already fully trained in his field and in performing that procedure or device use. The telementor-advisor is available in the operating room via two-way video and audio to give guidance that adds depth of experience or knowledge for the surgeon performing the procedure. The telementor-advisor interacts but typically would not have the authority to intervene in the procedure. However, depending on the circumstances and with the appropriate type of authority, the telementor could start out as an "advisor" and based on observations and need, progress to being a "preceptor".

Telementor-Preceptor: A telementor-preceptor, who might also be called a "telesupervisor," observes and mentors but also has the right and responsibility to intervene and direct the individual that is performing the procedure. This potentially involves actual participation in patient care through remote direction. This allows for the teaching of new procedures and the use of new devices in a safe and secure environment An additional purpose of the telementor-preceptor may be peer review and observation. It could make sense to use a telementor-preceptor where there are doubts about the sufficiency of judgment or knowledge of the onsite surgeon, who would benefit by the education, but it would not seem appropriate where technical procedural skills were in serious doubt after teleobservation.

Telemedicine Practitioner: Although some states have statutorily defined telemedicine broadly to include consultation and education using interactive video or data communications (so as to cover telepreceptor or conceivably even a telementor), for purposes of this analysis the term telemedicine practitioner is used to describe a practitioner (proceduralist or otherwise) who actual performs patient care through virtual presence at a remote site. This requires authority to control a patient's treatment and care and the legal ability to practice in the state where the patient is physically located. Current examples of telemedicine include remote operative neuromonitoring, teleradiology or robotic surgery from a remote location.

Some of the difficulties in developing standardized industry-wide terminology is compounded by the fact legislators throughout the county are developing terminology specific to their own states and statutes as telemedicine issues (ranging from reimbursement to standard of care) continue to become more prevalent. Nevertheless, the healthcare and remote presence technology industries would benefit from consistent terminology.

(1) Contributed by Gregory Drutchas and Keith Wright, health lawyers in Detroit Michigan with the firm of Kitch Drutchas Wagner Valitutti Sherbrook. They devote a very substantial part of their practice to medical staff, peer review and telemedicine issues.

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Aquarius - courtesy of NASA.

a nephrectomy was conducted where the porcine model was at Intuitive Surgical's laboratory in Sunnyvale, CA and the surgeon, using the 'surgeons' console, was located in Cincinnati and a second time in Denver.7

This particular series of experiments provided a better understanding of how remote surgery could be performed. TATRC, again working with UC and NASA, funded several research efforts where teams of surgeons and astronauts lived in the Aquarius Habitat off the coast of Key Largo, FL. Known as the NASA Extreme Environment Mission Operations (NEEMO), several missions were supported, including NEEMO 7, 9 and 12. On each mission, Dr. Timothy Broderick and Dr. Anvari participated along with several physician astronauts and technical personnel either as a crewmember or topside research. The research activities involved taking robotic systems to the habitat, which is approximately 60 feet underwater and conducting a series of experiments. The robotic system in NEEMO 9 was a Zeus arm. In NEEMO 12, SRI provided their M7 and the University of Washington's Biorobotics Laboratory provided their Raven robotic system. In NEEMO 12, the robotics systems were operated remotely from the ATA Annual Meeting in Nashville (2006) and from the Cincinnati Museum Center. These series of activities provided additional opportunity to evaluate and validate the ability to remotely operate a surgical system in an isolated, extreme environment.8

To further evaluate the capability of remote surgical capability using M7 and/or the Raven, additional 'telesurgery' experiments were developed and conducted. In the NEEMO experiments, the Aquarius habitat was wired or tethered to the surface, where the signal was wirelessly transmitted from the water's surface (buoy) to a terrestrial infrastructure. The next logical step was to evaluate how telesurgery could be done with a complete wireless network. Again UC partnered with TATRC and University of Washington to deploy a robotic system, Raven, an extreme environment. AeroVironment was contracted to provide an unmanned aerial vehicle (UAV) for communications support. In the high desert, north of Simi Valley, CA, a set of experiments were conducted with portable electrical power, a robotic system and a control system, which were separated by a little over 100 feet. The UAV provided the communications link between the two systems.10

After this work was completed several books and book chapters have been written, including Jacob Rosen, Blake Hannaford and Richard Satava's book entitled 'Surgical Robots'; Sajeesh Kumar and Jacques Marescaux's book entitled 'Telesurgery'; and Rifat Latifi's book 'Telemedicine for Trauma, Emergencies, and Disaster Management'. These are but a few reference tools that provide a foundation for moving telesurgery forward.

In the Rosen book, Dr. Gerry Moses and I presented a chapter on 'Overcoming Barriers to Wider Adoption of Mobile Telerobic Surgery: Engineering, Clinical and Business Challenges'. In this chapter, a number of challenges and barriers were discussed and these, discussed below, lay the foundation for how we might move forward, or at least begin a more fruitful discussion.

Where is it going?

A short summary of research activities in telesurgery has been presented. Much has been funded in the US by the military. In Strasbourg, France Dr. Marescuax runs the European Institute of Telesurgery at the Institut de Recherche contre les Cansers de l'Apparell Digestif and there are other activities ongoing. However, in the US, funding has diminished from federal sources. For telesurgery to become new tools in surgical care, where patient and surgeon are separated by some distance – not just in a different room, then engineering challenges, non technical challenges, and a strategy must be discussed in a meaningful way concomitant with the necessary financial resources to move it forward.

Engineering challenges include a variety of thought provoking issues such as technology, access, redundancy, reliability, interoperability, maintenance, ease-of-use, haptics, telecommunications, and latency. Non-technical challenges include personnel; cost of technology, communication, and personnel; cost of inaction; liability; licensing and credentialing; ethics; user acceptance; financial models; research data; animal trials and human clinical trials.

None of these challenges have really been adequately addressed for telesurgery to be commonplace. Perhaps we are at a crossroads, where telementoring, while not prolific, is an acceptable tool and surgery at a distance is still in development. Telesurgery is not science fiction; it has been shown to work. Much has been done and there is much more to do. It has been an interesting journey and with the growing challenges our healthcare system faces, perhaps our journey will get even more interesting.

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TELEMENTORING USING GOOGLE GLASS

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Figure 1: Dr. Assad-Kottner using Glass to livestream the case to Dr. Fontenot

The foramen ovale is a connection between the right and left atria which is open (patent) in the fetus and closes in most infants spontaneously. About 10 percent remain open after birth and usually produce no symptoms. But there are some circumstances that may require closure. This can now be performed by a catheter, i.e. percutaneous.

According to Dr. Uretsky "Most interventional cardiologists who treat adults do not have extensive experience in closing a PFO. Although we felt comfortable doing the procedure, utilizing a mentor with expertise directly benefits the patient. After access was obtained, we spotted a mobile artifact on echocardiography at the end of the closure device highly suggestive of thrombus. These images were transmitted to the telementor who agreed with the diagnosis and suggested at this point to retrieve the device to avoid the possibility of a thromboembolic event (Figure 2, 3). When the device was retrieved, the suspicion was confirmed, with a thrombus noted at the device tip (Figure 4). The telementor further guided the operators to flush the sheath and adequately clean the thrombus from the device, with excellent results. The patient was discharged much improved "(1)

Figure 2: Monitor in which Dr. Fontenot was observing the procedure

Google Glass is a wearable computer that is currently in a prototype phase ("Explorer" version). In essence, it is wireless extension of a mobile device ("smart" phone or tablet) with visual capability. Like a mobile device, the potential of Glass does not rely solely on its hardware but on the software/apps which are currently being developed. There are five components ": 1) bone conduction transducer that is able to transmit audio through the temporal bone and mastoid process, 2) a microphone that captures voice and allows user to make phone calls and video conferences, 3) a camera that can record 5 megapixel photographs and 720p HD video that can be transferred live via the internet, 4) a computer with gyroscope, GPS, Wi-Fi, Bluetooth, and 12 GB of storage, and 5) a prism which provides the Glass display to the wearer.

Dr. Assad-Kottner was asked what challenges he had experienced when trying to use Glass in the hospital. He explained: "Glass establishes a connection between 2 or more individuals using Google's Hangout platform. This means that the information being transmitted between the individuals is not HIPAA compliant. In our case we had a detailed conversation with the patient and his family regarding this issue and they provided a signed informed consent.

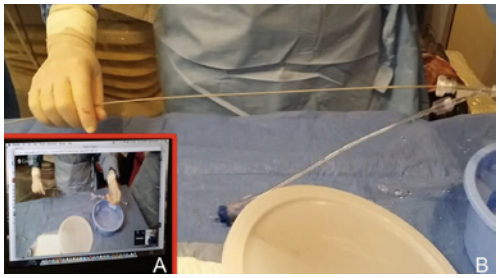

Figure 3: A. Screen being observed by Dr. Fontenot. B. Glass view perspective at same time

Second, the quality of the videoconference is directly related to the bandwidth speed (both upload/download) of the network Glass is connected to. In order to have a good conference experience at 30 frames per second a connection of 2 megabits per second is required. Speeds can be lower but this will affect the quality of the video stream. In addition, if procedure is performed in a cath lab, leaded walls will likely degrade the network signal. Also, battery life does not last long if using it in videoconference. A fully charged battery can drain in less than 30 minutes. For this reason an external battery pack is usually required."

The concept of telementoring is becoming a feasible and accessible option for many professionals. As Dr. Christian Assad-Kottner explained, the reason for this is directly related to "Moore's law" which states that every 18-24 months the number of transistors in an integrated circuit doubles. What this means is that technology is exponentially becoming cheaper, smaller, faster and more powerful and therefore more accessible. In

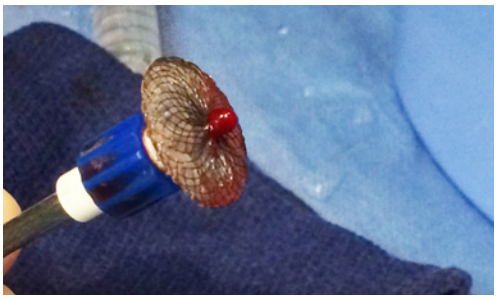

Figure 4: Thrombus at the tip of the Amplatzer device observed by tele-mentor and UAMS treating physicians

2014 the number of mobile-connected devices will exceed the number of people on earth and mobile data is expected to grow 11 times in the next 4 years reaching a whopping 18 exabytes (1 billion gigabytes) of transferred information. This is the reason why telemedicine, telehealth, and now telementoring are getting so much attention. We are entering an interconnected era in which wearable technology will empower individuals to communicate with each other seamlessly.

The UAMS team is now working to optimize transmission so as to view catheterization procedures in different locations within the institution with the ability of interventional colleagues to view and consult on the best approaches to manage the patient and improve patient outcomes.

1... Journal of the American College of Cardiology ["Tele-Mentoring": an interventional procedure using a wearable computer: first-in-man. JACC 2014; 63:1022-1022]

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About the author:

Professor Charles R. Doarn serves as a special assistant to Chief Health and Medical Officer at NASA and is an editor in chief of the Telemedicine and e-Health Journal. He has taken an interesting journey through academic medicine, spending nearly 15 years in surgery at Yale, Virginia Commonwealth University and the University of Cincinnati. He worked closely with colleagues in developing several telesurgery projects at UC funded in part by the US Army's Telemedicine and Advanced Technology Research Center. In addition, he is an editor-in-chief of the Telemedicine and e-Health Journal, a job he shares with surgeon, Ronald Merrell. Mr. Doarn authored NASA's strategic plan for Telemedicine and has published over 200 manuscripts, editorial, federal reports and book chapters.

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