Telemedicine: Back to the Future—a 50 Year Perspective

Ronald S. Weinstein, M.D.
Director, Arizona Telemedicine Program
University of Arizona, Tucson, AZ

President Emeritus
American Telemedicine Association

Hall of Fame
US Distance Learning Association
Disclosures

- OWLCAT (Educational Software)
- Corabi International Telemetrics
- Apollo Telemedicine
- Health Street
- DMetrix
- UltraClinics

© 2013, Arizona Telemedicine Program
Venture Capitalist’s Guideline

Defining Success – 20 Companies Funded

1 in 20 - “Home Run”

3 in 20 - Break even – stay in business

17 out of 20 - Will go under
Disclosures

- OWLCAT (Educational Software)
- Corabi International Telemetrics
- Apollo Telemedicine
- Health Street
- DMetrix
- UltraClinics
Massachusetts General Hospital-
Logan Airport Medical Station
1963-1975 Kenneth T. Bird, M.D.
Where it all started – Logan Airport Gate 23
Boston Logan Airport Medical Station – Connecting to the Massachusetts General Hospital
Nurse aiming “portable” camera
“In a test conducted at Massachusetts General Hospital (1967), Robert Scully examined a hundred remote projected slides including routine surgical specimens, stained blood smears, and white counts. He was able to identify all of them correctly using black and white television, although occasionally asking color information of the distant technician who was reviewing the slides directly.”
Massachusetts General Hospital Pathology Staff & Residents (1966)
The Press Takes Note

Medical World News
July 26, 1968

Piping Patients to Doctors via TV

© 2010, Arizona Telemedicine Program
MGH-Logan International Airport Telemedicine Program (1968-1975)

- Department of Veterans Affairs
- STARPAHC
- Clones (Phelps-Dodge, Playas, N.M.)
- Secondary Clones (Georgia & Arizona)
- Innovation (i.e., 1986-Telepathology)
Mother and newborn in STARPHAC mobile telemedicine vehicle
MGH-Logan International Airport Telemedicine Program
(1968-1975)

- Department of Veterans Affairs
- STARPAHC (~3 Years - federal funding)
- Clones (Phelps-Dodge, Playas, N.M.)
- Secondary Clones (Georgia & Arizona)
- Innovation (i.e., 1986-Telepathology)

© 2013, Arizona Telemedicine Program
Genesis of Telepathology in the United States

- Massachusetts General Hospital-Logan International Airport Telemedicine Program (1963-1977)
  - Television Microscopy (1968)

- National Bladder Cancer Project (1973-1990)
  - Robotic dynamic telepathology/static image
  - National Cancer Institute-funded program
  - 12 clinical sites/17 clinical protocols
  - Central Pathology Laboratory (CPL)
  - 15,000 bladder specimens; 17,000 cytopathology specimens re-reviewed
  - Pathology interobserver variability issues
Action Items

1. Validation of video microscopy

2. Human performance studies for telepathology

U.S. National Demonstration of Dynamic Robotic Telepathology

Alexander W. Miller III, M.D., Telepathologist.
Telepathology
Invent » patent » construct » commercialization - cycle
(1984-1996)
Contingent from Shangdong University, China
Metastatic Gastric/GEJ Cancer Treatment

Herceptin is targeted therapy for HER2+ metastatic stomach/GEJ cancer

Herceptin is a monoclonal antibody — a type of targeted therapy — shown in preclinical studies to target cells with too many HER2 receptors.1

How Herceptin may work1,2

In preclinical studies, Herceptin was shown to attach to HER2 receptors.

Signal
Nucleus

HER2-normal stomach cancer cell
HER2 receptors send signals telling cells to grow and divide

HER2+ stomach cancer cell
Too many HER2 receptors send more signals, causing cells to grow too quickly

How Herceptin may work
Herceptin may stop the HER2 receptors from signaling the cell to grow

Side Effect Information

• Worsening of low white blood cell counts associated with chemotherapy has also occurred
• You must have a HER2 test to determine if your stomach cancer is HER2-positive before taking Herceptin
• The most common side effects associated with Herceptin are low white blood cell counts, diarrhea, fatigue, low red blood cell counts, swelling of the mouth lining, weight loss, upper respiratory tract infections, fever, low platelet counts, swelling of the mucous membranes, swelling of the nose and throat, and a change in taste

References
ARIZONA
Telemedicine
Program

1996
Telemedicine

The Institute of Medicine defines telemedicine as “the use of electronic information and communications technologies to provide and support health care when distance separates the participants.”
“Western Governors are committed to improving access to and quality of health care for people living in the rural west.”
Western Governor’s Association
Telemedicine Action
Report 1995 - Barriers

- Infrastructure Planning & Development
- Telecommunications Regulation
- Reimbursement for Telemedicine Services
- Licensure & Credentialing
- Medical Malpractice Liability
- Confidentiality
Dr. Ronald S. Weinstein & AZ State Senator Bob Burns
>1.3 Million Cases
It was back in 1983 that Bob Burns — then a State Representative, now a Commissioner with the Arizona Corporation Commission — presented his landmark proposal to Jim Dulan, MD, Vice President for Health Sciences and Dean of the College of Medicine at the University of Arizona. Burns’ idea was to create a pilot telemedicine program, to try to expand health care options for people in rural Arizona. Dulan’s response was an emphatic “Yes!” Ronald S. Weinstein, MD, was then head of the Department of Radiology, and already working in telemedicine, a branch of telemedicine. When Dulan asked Weinstein if he would head up the project, the response was equally affirmative.

The Arizona Legislature provided the funds to start the Arizona Telemedicine Program (ATP) three years later, and has funded it every year since.

ATP went live in 1990 from its home base at the University of Arizona, via telecommunications links with the Maricopa Community Health Centers in Nogales, Arizona, and the state Department of Corrections prison in Yuma.

Since then, the program has grown exponentially and stimulated the growth of many affiliated programs in Arizona. ATP’s broadband network now connects 160 sites in more than 70 Arizona communities. Number of cases handled more than 1 million.

Now a patient in a remote community can benefit from immediate access to highly talented specialists who can diagnose the patient’s cardiac or chest condition or stroke as rapidly — and as accurately — as if the patient and specialist were in the same room.

This report will give you a look at some of Arizona’s outstanding telemedicine programs. For example:

- A tele-echo cardiology system in Yuma Regional Medical Center’s neonatal ICU, enabling rapid diagnosis of critical cardiac conditions in newborns. (Page 9)
- A nationally recognized distance learning program for physicians, nurses and other health professionals. (Page 12)
- Flagstaff Medical Center’s long-distance monitoring program for patients with congestive heart failure — including patients without electricity in their homes. (Page 20)
- A teleophthalmology program for Native Americans that provides early detection and treatment for diabetic retinopathy, reducing medical costs for people who lose their sight. (Page 23)
- The telestroke program started by the Mayo Clinic — Scottsdale and the Arizona Department of Health Services, which has equalized stroke care at small rural and larger urban hospitals. (Page 28).
- The Banner Health electronic Intensive Care Unit, which links a two-way audio/ video monitoring system in every ICU patient room to a remote team of nurses and doctors who back up the ICU staff. (Page 28)

So many new ideas have been put into practice over the last 20 years, it amazes all of us who have been with the program since the early days.

The results have been all that we — and the Legislature — hoped for. Governor Jan Brewer summed it up nicely on May 23, 2011, when she signed Senate Bill 1283, the Telemedicine Telebursertment Parity Act, which requires health insurers to cover many telemedicine services on par with clinic visits. The Arizona House and Senate passed the bill without a single ‘nay’ vote. (Page 19)

“Telemedicine saves money,” Governor Brewer said, “and it saves lives.”

To that we can only add: It’s been a great 20 years.

Robert “Bob” Burns
Co-founder, Arizona Telemedicine Program Chair, Arizona Telemedicine Council

Ronald S. Weinstein, M.D.
Co-founder and Director
The T-Health Institute was established by the University of Arizona in 2003, as a Phoenix division of the Tucson-headquartered Arizona Telemedicine Program. Located on the Phoenix Biomedical Campus in downtown Phoenix, T-Health’s mission is to offer telemedicine and telehealth training programs and to create “next-generation” innovations in education and health-care delivery, especially those that leverage advances in medical informatics, wireless telecommunications, telematics/telehealth, simulation, and robotics. Ronald S. Weinstein, MD, is the founding director of the Arizona Telemedicine Program and executive director of its T-Health Institute.

The T-Health Institute’s international award-winning T-Health Amphitheater was designed by Dr. Weinstein and former executive director of Biomedical Communications Richard McNeely. It serves as a University of Arizona College of Medicine “e-Classroom of the Future.” Experimental education programs, including an innovative medical science curriculum for K-12 students and Interprofessional Education and Practice (IPEP) exercises, are tested in the T-Health Amphitheater. Staff at the T-Health Institute also are engaged in translational research on the development of a next generation of clinical decision support systems. The focus of interest is the acute management of traumatic brain injury and septic cardiac death. This is in support of the Arizona Emergency Medicine Research Center – Phoenix.

Arizona Corporation Commissioner Burns, Arizona Senator Gail Griffin, Dr. Weinstein, Stuart Flynn, MD, dean of the UA College of Medicine – Phoenix and Steven Goldschmidt, MD, dean of the UA College of Medicine – Tucson watch as Governor Jan Brewer signs the Telemedicine Reimbursement Parity Act into law in the T-Health Amphitheater on the campus of the University of Arizona College of Medicine – Phoenix. This bill requires telemedicine services in rural areas of Arizona to be covered by health insurance. Beginning in 2015, insurers must cover services provided through telemedicine service programs if the insurers pay for those same services when they are provided in a traditional clinic or hospital setting.

Governor’s ceremonial signing of Senate Bill 1353 in the T-Health Amphitheater on the University of Arizona College of Medicine – Phoenix campus.
160+ Sites

- Urban & rural hospitals
- Native American healthcare
- Prisons & jails
- Community health centers
- Schools
- Distance learning affiliates
- International Sites

© 2013, Arizona Telemedicine Program
Today - 55 Health Care Organizations

First Arizona Telemedicine Program Users Group Meeting (1997)
Telemedicine Services
**Telemedicine**

**Subspecialty Consultations**

<table>
<thead>
<tr>
<th>Anesthesiology</th>
<th>Neurosurgery</th>
<th>Peds. Orthopedics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiology</td>
<td>Ob/Gyn</td>
<td>Peds. Psychiatry</td>
</tr>
<tr>
<td>Dental</td>
<td>Ophthalmology</td>
<td>Peds. Pulmonology</td>
</tr>
<tr>
<td>Dermatology</td>
<td>Orthopedics</td>
<td>Peds. Rheumatology</td>
</tr>
<tr>
<td>Endocrinology</td>
<td>Otorhinolaryngology</td>
<td>Peds. Urology</td>
</tr>
<tr>
<td>Fam. &amp; Comm. Med.</td>
<td>Pain Clinic</td>
<td>Psychiatry</td>
</tr>
<tr>
<td>Gastroenterology</td>
<td>Pathology</td>
<td>Radiology</td>
</tr>
<tr>
<td>Genetics</td>
<td>Peds. Cardiology</td>
<td>Reprod/Infertility</td>
</tr>
<tr>
<td>Geriatrics</td>
<td>Peds. Dermatology</td>
<td>Rheumatology</td>
</tr>
<tr>
<td>Hematology/Oncology</td>
<td>Peds. Endocrinology</td>
<td>Sports Medicine</td>
</tr>
<tr>
<td>Hepatology</td>
<td>Peds. Gastroenterology</td>
<td>Surgery</td>
</tr>
<tr>
<td>Infectious Disease</td>
<td>Peds. Hem/Onc</td>
<td>Surgical Oncology</td>
</tr>
<tr>
<td>Integrative Medicine</td>
<td>Peds. Infec. Disease</td>
<td>Transplantation</td>
</tr>
<tr>
<td>Internal Medicine</td>
<td>Peds. Nephrology</td>
<td>Toxicology</td>
</tr>
<tr>
<td>Molecular Diagnostics</td>
<td>Peds. Neurology</td>
<td>Urology</td>
</tr>
<tr>
<td>Nephrology</td>
<td>Peds. Ophthalmology</td>
<td>Vascular</td>
</tr>
<tr>
<td>Neurology</td>
<td>Peds. Oral Surgery</td>
<td>Wound Management</td>
</tr>
</tbody>
</table>

© 2013, Arizona Telemedicine Program
“Telemedicine saves hundreds of thousands of dollars in travel expenses for doctors, nurses and patients each year.”

Robert Kerr
Budget Analyst, Principal
Arizona Telemedicine Program
Teleradiology – 1,300,000+ cases

© 2010, Arizona Telemedicine Program
DMetrix-
Whole Slide Image Telepathology
Innovations in Digital Pathology Slide Processors

Weinstein et al, Human Pathology, 2001
microscope format considerations

- Two considerations:
  - How many objectives ($N_{obj}$) needed to span width of object ($W$)?
  - How many objectives fit into size of array?
- Constraints on array size:
  - Width of object (e.g., glass slide) ($W$)
  - Length of array ($L$)
  - Ratio ($\rho$) of field of view size ($w_{FOV}$) to optics size
    - Conventional: $\sim 1:25$
    - Array microscope: $\sim 1:7$

\[ N_{obj} \geq \frac{W}{w_{FOV}} \]
\[ N_{obj} \leq \frac{\rho^2 WL}{w_{FOV}^2} \]
Miniaturized microscope
DMetrix lenslet array
3 stacked lenslet arrays = 1 lenslet array ensemble

The innovative bundling of teleradiology, telepathology, and teleoncology services

Teleradiology, telepathology, and teleoncology are important applications of telemedicine. Recent advances in these fields include a preponderance of radiology PACS (Picture Archiving and Communications System) users, the implementation of around-the-clock teleradiology services at many hospitals, and the invention of the first ultrarapid whole-slide digital scanner based on the array microscope. These advances have led to the development of a new health-care-delivery clinical pathway called the ultrarapid breast care process (URBC), which has been commercialized as the UltraClinics® process. This process bundles telemammography, telepathology, and teleoncology services and has reduced the time it takes for a woman to obtain diagnostic and therapeutic breast-care planning services from several weeks to a single day. This paper describes the UltraClinics process in detail and presents the vision of a network of same-day telemedicine-enabled UltraClinics facilities, staffed by a virtual group practice of teleradiologists, telepathologists, and teleoncologists.
Telepsychiatry
‘Care Beyond Walls and Wires’ Enhances Life for Patients with Congestive Heart Failure

Woody Smith and his daughter, Rita Yazzie, used to drive as often as twice a month from their home on the Navajo Reservation to Flagstaff Medical Center, nearly two hours away. Mr. Smith is living with congestive heart failure, with symptoms so severe he required frequent hospitalizations.

But Mr. Smith can now go months without having to return to the hospital. His health has resulted from a program called Care Beyond Walls and Wires, a telemedicine-enhanced program that helps nurses and providers improve the health of patients with congestive heart failure.

The program allows caregivers to do at-home visits and provide education on how to stay for those with heart conditions.

“Care Beyond Walls and Wires is the best thing for my dad,” says Rita Yazzie, Woody Smith’s daughter. “It’s helped him to avoid two hospital readmissions, which is very important.”

And at 90, Mr. Smith has been able to return to his favorite activity: riding his horse.

Care Beyond Walls and Wires provides patients with a backpack containing the equipment they need to check their blood pressure, measure their oxygen level, and check their weight daily; the latter because patients with CHF can gain and lose weight suddenly. The data are automatically transferred to a smartphone that transmits the information to Northern Arizona Healthcare’s care coordination office, which provides the smartphone, monitoring equipment, and backpack to every patient enrolled in Care Beyond Walls and Wires.

Some of the program’s patients have no stable source of income, often on Social Security. The San Diego telecommunications company Qosina was chosen to lead the project, with Maryland-based Zephyr Technology and Verisio providing software, smart phones and remote-monitoring hardware.

Northern Arizona Healthcare agreed to a pilot project involving 50 patients, and the project got under way in July 2015.

Woody Smith was one of the first enrolled, along with a woman he knows in Flagstaff, and another woman who is his room mate.

The idea of the program was to improve care for patients in rural areas, like the Navajo Reservation, where access to medical care can be challenging. The program was developed in partnership with the National Institutes of Health, Public and Private Partnerships, which was looking for better ways to monitor patients with CHF who live in rural areas. The goal was to provide better care while keeping the patients out of the hospital, thus reducing health care costs.

Northern Arizona Healthcare case manager Tammy Socorro says, “We couldn’t have asked for anything more. It’s a global win.”

Rita Yazzie
Neonatologist Greg Warda, MD, arrived at Yuma Regional Medical Center 15 years ago as the hospital’s only neonatologist and medical director of the neonatal intensive care unit (NICU). Back then, Dr. Warda’s most urgent challenge was determining when a sick baby could remain in the Yuma hospital or needed to be transported to a larger hospital where multiple specialists could oversee the baby’s care.

If a baby showed signs of congenital heart disease, for example, diagnosing the problem could take hours, even days. An echocardiogram would have to be done, but the hospital lacked technicians trained to do an “echo” on a newborn. That sometimes meant the study had to be repeated. In any case, the echocardiogram—either on paper or DVD—would have to be shipped to Tucson or Phoenix or San Diego to be read by a pediatric cardiologist.

It could take a week or 10 days to get a final diagnosis.

For the parents of the newborn, it was an agonizing process, often compounded by the need to transport the baby to a larger hospital 200 or more miles away. Families often were split apart. The father likely had to stay in Yuma to work. If the mother had a C-section, she might have to stay behind as well. And even if she could go, there was the problem of lodging and being able to afford it.

“There were just all kinds of issues, for us and for the parents,” Dr. Warda recalls. “Fortunately, a lot of that has changed.”

The changes came in 2006, when Yuma Regional Medical Center signed a new contract with the Arizona Telemedicine Program.

That linked Dr. Warda and his team at Yuma Regional—which, since 2009, includes Nitin Mathur, MD, the hospital’s second full-time neonatologist—to the pediatric cardiologists and other specialists at The University of Arizona Medical Center in Tucson.

Instead of having to ship a DVD, the echocardiogram is now be transmitted over the broadband telemedicine network. In most cases, Dr. Warda gets a definitive diagnosis almost immediately, or within the same day.

“We’ve had a number of cases where we would have a heart murmur on a baby who was otherwise fine, only to find out that the baby had to be transported immediately,” Dr. Warda says. “And if we hadn’t been able to do that echo via telemedicine, we would have had the baby go home. And the baby would have come back to us in heart failure or worse, the baby could have died. Telemedicine has saved so many babies.”

Dr. Daniel Lax heads the University of Arizona Health Network’s tele-echo program, which includes her and four other pediatric cardiologists. Another huge benefit of telemedicine, Dr. Lax says, is that the pediatric cardiologist is often available to view the echocardiogram while the technician is doing the study.

“That allows us to coach the technician, to tell them if we need a closer look, for example, and the result is that they are now very well trained to do excellent studies,” Dr. Lax says.

Each week, Dr. Lax’s group consults on four or five Yuma pediatric echocardiograms. She says the doctors also spend a day and a half each month in Yuma, following up on babies and children who were born with heart disease or defects.

While most of the cases referred to Dr. Lax and her colleagues involve newborns, the doctors saw patients as old as 18, or older if the patient was born with congenital heart disease.

This collaborative effort resulted in the publication of a seminal article authored by Dr. Lax, Dr. Warda and colleagues, published in 2012 in Telemedicine and e-Health, the leading telemedicine journal. It confirmed that neonatal echocardiograms viewed and interpreted via telemedicine are as accurate as echocardiograms recorded and shipped to the interpreting physician in another city. And both are indispensable in the remote diagnosis of congenital heart disease.

Dr. Warda expects telemedicine will continue to play a vital role in his newborn ICU, especially as the technology continues to evolve.

“I can’t say enough about the university cardiologists over in Tucson,” Dr. Warda adds. “They’ve all been wonderful. They’ve all made themselves as available to us as they can be. They have never hesitated to help us out.

“They’re also really nice just to be able to talk to them while the study is going on,” says Dr. Warda.

“It builds up a camaraderie and a comfort zone when you can put a face to the name.

“The greater benefit is to the families,” Dr. Warda says. “They can be right there with their baby and get a diagnosis from the cardiologist in Tucson almost right away. And I can tell you, when you have a baby who’s sick, that means so much. Instead of having to wait until tomorrow or the next day or even longer to get an answer.”

Yuma Regional Medical Center

Dr. Daniel Lax, MD
Pediatric Cardiologist
University of Arizona Health Network, Tucson, AZ

Gregory R. Warda, MD
Neonatologist
Yuma Regional Medical Center
Infectious Disease
Yes, telemedicine did feel weird at first. But it works. You get used to it. I think it’s the wave of the future.”

Patient
Providing Health and Wellness Information to Cancer Survivors and Health Care Professionals

Survival is just one goal for cancer patients. These monthly multi-site video gatherings offer patients information in Spanish and English to help them live healthier, more fulfilling lives.

Kathie McHugh is a breast cancer survivor, grateful and proud to be seven years out from the day she was diagnosed. She also likes to describe herself as “a very thrifty information seeker,” who feels her health and well-being have been greatly enhanced by monthly meetings of an educational program called ¡Vida!®.

¡Vida!® — the name comes from the Spanish word for life — began with grant support from the Susan G. Komen Foundation in 2006.

¡Vida!® grew out of our work with breast cancer survivors who told us that they wanted information to help them not just survive, but to be healthy and live well,” says Ana Maria Lopez, MD, MPH, who is ¡Vida!® director, medical director of the Arizona Telemedicine Program, and a University of Arizona Cancer Center oncologist who specializes in breast cancer.

“As patients, they need and want to be well prepared to take charge of their health.”

Guided by a broad-based community advisory group, ¡Vida!® has been proactive in addressing the information needs of patients and their families across the state of Arizona.

While ¡Vida!® originally began with a focus on breast cancer survivorship, the series has evolved to include topics related to lifestyle medicine, wellness, and advocacy, with the overarching goal of engaging Arizona’s citizens in their own health. Recent ¡Vida!® sessions have covered such varied topics as young women and cancer, medicinal plants of the Sonoran Desert, the Affordable Care Act and Medicaid expansion, and breathing techniques that lead to relaxation.

“As patients and their families have repeatedly informed us, the cure to the stress and anxiety that their illness brings is knowledge and information,” Dr. Lopez says.

The program offers monthly sessions developed for both patients and health-care professionals. The sessions are offered to a local audience at the University of Arizona Health Sciences Center campus and University of Arizona Cancer Center in Tucson.

Each program is first offered to physicians and other health-care professionals, so they can be prepared to respond to questions from patients who attend the ¡Vida!® sessions. The sessions for professionals also offer continuing medical education credit.

All of the Arizona Telemedicine Program’s 160 statewide sites are able to connect to ¡Vida!® via the program’s telecommunications technology, which allows for fully interactive videoconferencing, or through UA Biomedical Communications, which facilitates real-time and delayed video-streaming.

All sessions are permanently stored, so patients and professionals can watch as many times as they want, at their convenience.

Both patients and health care professionals say they appreciate the ease of learning through ¡Vida!®, as well as being able to interact by videoconferencing with the presenter. Patients say they feel better prepared to ask questions and learn more, and professionals say they feel better prepared to address patient concerns.

Acknowledging the diversity of Arizona communities, the patient series is offered twice on the same day: one session in English and one in Spanish.

“Over time, the groups began to connect, either figuring after one session or coming in early for the other,” Dr. Lopez says. “The groups could not always communicate effectively through language, but the participants found music to be the language that could bridge them. They began to play music in between the sessions and move and dance, in Tucson, in Nogales, in Payson, and in all participating sites across Arizona.

“I think of music as the universal language,” Dr. Lopez says. “Our participants now come together month after month, and to celebrate health through movement!”

Ms. McHugh, who lives in Tucson, started attending ¡Vida!® meetings regularly in 2013, on the recommendation of a social worker who leads a support group that she attends. In addition to being a breast cancer survivor, she underwent surgery in May 2013 for what turned out to be a benign ovarian tumor – still, a frightening experience.

Last year, Ms. McHugh was asked to serve on the ¡Vida!® planning committee. “I was delighted to have a chance to pay it forward” to all the people who have saved my life,” she says. Ms. McHugh leads the dance breaks.

Ms. McHugh has gained more than information from ¡Vida!®. She and Isela Macias, another participant, were volunteering together on ¡Vida!® when they learned they are practically neighbors. Now they are close friends. “It is amazing,” Ms. McHugh says, “that the blessings that come from ¡Vida! are so rich.”
Teledermatology
Tele-Urgent Care

Teletrauma
- University of Arizona Health Network (multiple communities)

Telestroke
- Mayo Clinic Telestroke Network (11 rural communities)

eICU (electronic Intensive Care Units)
- Banner Health eICU Network (7 Banner hospitals)
Teletrauma

Over Crowded Roll Over Vehicles Smuggling Illegal Immigrants: 41 people in a pick up truck
Telestroke

TeleStroke
Supporting Community Hospitals
Stroke is the third leading cause of death in the United States and the leading cause of adult disability. Approximately 795,000 strokes occur each year, and delays in diagnosis contribute to the mortality and disability associated with stroke.

TeleStroke supports community hospitals by providing:

- 24-hour on-call stroke specialist
- Emergency department acute stroke consultation
- Bedside follow-up (depending on site needs)
- Stroke follow-up appointments (depending on site needs)

**WHEN STROKE BEGINS, EVERY SECOND COUNTS**

Stroke is a medical emergency that requires early assessment and early treatment. Rapid identification of acute stroke patients enables the timely administration of effective and appropriate stroke therapies that can improve patient outcomes. It also allows for initiation and coordination of strategies to prevent stroke progression, recurrent stroke, and common complications.

*Keep stroke patients close to home.*

With TeleStroke, community hospitals can provide stroke care to

**HOW TELESTROKE WORKS**

**COMMUNITY HOSPITAL**

1. Doctor reviews patients status, determining need for stroke evaluation
2. Telestroke mobile unit brought in to patient
3. Patient speaks directly to the TeleStroke doctor and follows examination instructions
4. If necessary, hospital staff prepares patient for AirMed transport
5. Telestroke doctor receives call or page
6. Doctor begins video conferencing and evaluates patient data
7. Exam given via TeleStroke system to evaluate presence or severity of stroke
8. Consultation with community hospital on best treatment plan for patient
Reduced Costs

The efficient use of available health care resources is of paramount concern for all health care centers. And, the costs associated with establishing a comprehensive stroke care system may prevent smaller or more rural facilities from implementing effective stroke management.

Telestroke

Resource constraints no longer need to be an obstacle to acute stroke services. For community hospitals and other facilities that cannot afford 24/7 coverage by a neurologist, the TeleStroke program is a cost-effective way to deliver round-the-clock specialty stroke care to more patients.
eICU (21 Banner Hospital Network)

Banner Health “Electronic Intensive Care Unit”
Value in Acute Care

Leverage scarce physician resources

Respond to requests for help from bedside care team

Monitor for adverse trends and interrupt before adverse trends become adverse outcomes

Monitor and support “Best Practices” compliance

Measure performance

Reduction in outliers, mortality and complications
Telemedicine Services
Telepresence
Telementoring
Telemedicine Services
Telepresence
Telementoring
Telepresence
Telemedicine Services

Telepresence

Telementoring
Surgical Telementoring News

Volume 1, Issue 1
May, 2014

Editor: Evelyn Baram-Clouthier
E-mail: editor@telesurgery.org

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.

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 knowledge.

TELESURGERY: IS THERE A FUTURE?
By Charles R. Doerr, 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

GLOBAL TELEMENTORING
Surgical Telementoring using a tablet - bridges two continents
In January 2014, Dr. Conor Delaney and Dr. Knut Magne Augstad at University Hospital Gjøvik, Norway, performed a laparoscopic surgical procedure on a woman with a tumor in her bladder. The surgery was performed in Norway, and the surgeons were located in the United States.

Telerobotics in endoscopic skull base 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 lifelong pursuit." At the University of Pittsburgh Medical Center (UPMC), they have developed a program for global education of surgeons that uses telementoring to bridge the gap between the laboratory and independent.

Telerobotics in Urology from Canada to 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 D’Ercole, Chair/Clinical Director of Surgery Western University. He has been conducting telesurgery education in urology from the Operator.

Specialty Societies join to improve skills
For the first time in the United States, several surgical specialty societies will join together to implement a project 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 professionals 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.

Surgical Telementoring in Pediatric Minimally Invasive Surgery
Dr. Steven Rothenberg in Colorado and his former fellow Dr. Todd Parnesky in Ohio, recently performed the first endovascular telementoring with a piece of equipment in a five-month-old infant. 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 performed.

Continued on page 2

Continued on page 3

Continued on page 4

Continued on page 5

Continued on page 6

A publication of the Foundation for Advanced Medical Education (FAME), a subsidiary of the American Medical Foundation for Peer Review and Education - www.telesurgery.org

W & D ORTH photograph courtesy of KARL STORZ Endoscopy-America, Inc. VR & D ORTH is a registered trademark of KARL STORZ Endoscopy America, Inc. Google is a registered trademark and Google Glass and Glass are trademarks of Google Inc., used with permission.
Surgical Telementoring using a Tablet - Bridges Two Continents

Continued from page 1

A new low cost and innovative telementoring 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 transanastomotic telescopy (drawings over a live video stream) enhanced the mentors teaching capabilities and made it so much easier to reach a common agreement on the key surgical anatomical locations (Figure 1). The mobility of the technology is also of key importance, as mentors can connect to any Wi-Fi or fast HSPDA (High speed packet access) 3G-cellphone network, or the new or the new LTE (4G) mobile network. In a busy hospital world, this is a huge advantage," says Dr. Delaney. In Norway, Dr. Lindesten, chief of 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.

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. Augustad, 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 teacher. Two surveys of laparoscopic telementoring, showed no significant difference in conversion, anastomotic leak or mortality compared to on-site mentoring. "In the review we perform," says Dr. Augustad, "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 video-conference technology on surgical practice is limited," says Dr. Knut Magne Augustad. In a recent systematic review, 34 surveys were identified and summarized. 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 telementoring 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.

Telementoring, 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 720 x 480 and higher is perceived to give high perceived video quality, whereas 320 x 240 and lower is evaluated to provide medium perceived picture quality. The most common telementoring feature is telescopy and it seems that this feature is mandatory for all telementoring solutions. The visual assisted mentoring utilizes telescopy, which has been used mostly in weather forecasts and broadcasted sport events since the early sixties. Telescopists allow surgeons to draw a freehand sketch over the live video stream, and enables the

Continued on page 3

A publication of the Foundation for Advanced Medical Education (FAME), a subsidiary of the American Medical Foundation for Peer Review and Education - www.telesurgery.org

Special thanks to KARL STORZ Endoscopy-America, Inc. for their generous support
Sustainability Issues

- “Meaningful use”
- Reimbursement
- Credentialing
- Interstate medical licensure
- Telecommunications costs
- Equipment obsolescence
New drivers creating need for virtual care models (ACO, etc.)

Physicians shortages – and increased numbers of patients entering the system

Consumer demands for more convenient health care services

“Killer” applications

A- Gap services; B-Urgent services; C-Mandated services

mHealth, eHealth, wireless, implantable
Physicians, Non-physician Clinicians, and Other Health Workers, 1850-2010

Adapted from Kendix and Getzen and the Bureau of Labor Statistics
Gifford Incident
Saturday, January 8, 2011

- Tucson Shooting of Rep. Gabrielle Gifford
- 6 Dead
- 12 Wounded
- Level I Trauma Center at University Medical Center in Tucson
Pre-Transfer Clinical Video Conferencing
University of Arizona and University of Texas
Memorial on front lawn, University Medical Center
Tucson, Arizona
Acknowledgements

**U of A Pathology**
Gail R. Barker, Ph.D.
Achyut K. Bhattacharyya, M.D.
Beth L. Braunhut, M.D.
John B. Carpenter, M.D.
Anna R. Graham, M.D.
Thomas M. Grogan, M.D.
Jeffery Henderson, M.D.
Robert Klein, M.D.
Fangru Lian, M.D.
Anna Maria Lopez, M.D.
Ray B. Nagel, M.D., Ph.D.
Lynn Richter, M.T. (ASCP)
Katherine M. Scott, M.D.

**U of A College of Optical Science**
Peter Bartels, Ph.D.
Michael Descour, Ph.D.
Chen Liang, Ph.D.
Rene V. Slack, Ph.D.
James C. Wyant, Ph.D.

**Arizona Telemedicine Program**
Kristine Erps
Michael Holcomb
Elizabeth A. Krupinski, Ph.D.
Christopher Martin
Janet Major
Phyllis A. Webster

**Massachusetts General Hospital**
Stanley Bullivant, Ph.D.
John Gilbertson, M.D.
Frederick B. Merk, Ph.D.
Jerry Nash, M.D.
Roger Williams, M.D.
Yukaka Yagi, Ph.D.

**DMetrix, Inc.**
James Goodall
William C. Russum
P. Zou, Ph.D.
Thank you

Ronald S. Weinstein, MD

ronaldw@u.arizona.edu
Tele-Home Health

Blood Glucose Monitor

Central Nurses Station

© 2013, Arizona Telemedicine Program
... waiting for a donor heart
Telestroke Networks

The American Heart Association/American Stroke Association (AHA/ASA) recommends the use of telemedicine, or telestroke, to improve stroke care in rural, remote, or underserved areas.

Discover how telestroke allows for specialized stroke care in underserved areas:

- **What Is Telestroke?**
  Learn about the different telestroke models.

- **Key Elements of a Telestroke System**
  Find out about equipment, challenges, and best practices associated with telemedicine.

- **Telestroke Resources**
  Explore resources on telestroke.

- **Telestroke Network Map**
  View telestroke networks on a national scale.

---

**Education and Training**

Free access to educational materials and training on acute ischemic stroke and Activase for your stroke center.

- **Learn More**

---

**Dosing and Administration**

View videos and instructions for the appropriate dosing and administration of Activase for acute ischemic stroke.

- **View Now**

---

**Register for Updates**

Receive updates and gain free access to order educational resources.

- **Register Now**

---

**Acute Ischemic Stroke Indication**

Activase is indicated for the management of acute ischemic stroke in adults for improving neurological recovery and reducing the incidence of disability. Treatment should only be initiated within 3 hours after the onset of stroke symptoms, and after exclusion of intracranial hemorrhage by a cranial computerized tomography (CT) scan or other diagnostic imaging method sensitive for the presence of hemorrhage (see CONTRAINDICATIONS in the full prescribing information).
Indian Health Services (STARPAHC) “Visionary in Telemedicine” Awards

Peter Decker, Project Engineer
Evelyn Tom, Community Health Physician Assistant
Peter Ruiz, Engineering Technician Lockheed Missiles & Systems Inc.
Indian Health Services (STARPAHC) “Visionary in Telemedicine” Awards

James Justice M.D., Director,
Community Health Medic Training
INTER-INSTITUTIONAL BLADDER CANCER QUALITY ASSURANCE PROGRAM (1983-1984)

Malignant vs. Benign

NATIONAL BLADDER CANCER PROGRAM
Central Pathology Laboratory
INTER-INSTITUTIONAL BLADDER CANCER QUALITY ASSURANCE PROGRAM (1983-1984)

NATIONAL BLADDER CANCER PROGRAM
Central Pathology Laboratory
INTER-INSTITUTIONAL BLADDER CANCER QUALITY ASSURANCE PROGRAM (1983-1984)
INTER-INSTITUTIONAL BLADDER CANCER QUALITY ASSURANCE PROGRAM (1983-1984)

Grading and Staging

1 2 3 4 5 6 7 8

NATIONAL BLADDER CANCER PROGRAM
Central Pathology Laboratory
INTER-INSTITUTIONAL BLADDER CANCER QUALITY ASSURANCE PROGRAM (1983-1984)

Grading and Staging

NATIONAL BLADDER CANCER PROGRAM
Central Pathology Laboratory
Innovations in Digital Pathology Slide Processors

Weinstein et al, Human Pathology, 2001
Miniaturized microscope
microscope format considerations

- Two considerations:
  - How many objectives ($N_{obj}$) needed to span width of object ($W$)?
  - How many objectives fit into size of array?
- Constraints on array size:
  - Width of object (e.g., glass slide) ($W$)
  - Length of array ($L$)
  - Ratio ($\rho$) of field of view size ($w_{FOV}$) to optics size
    - Conventional: ~1:25
    - Array microscope: ~1:7

Michael R. Descour, Ph.D. et al.
DMetrix lenslet array
3 stacked lenslet arrays = 1 lenslet array ensemble

DMetrix-
Whole Slide Image Telepathology
The innovative bundling of teleradiology, telepathology, and teleoncology services

R. S. Weinstein
A. M. López
G. P. Barker
E. A. Krupinski
M. R. Descour
K. M. Scott
L. C. Richter
S. J. Beinar
M. J. Holcomb
P. H. Bartels
R. A. McNeely
A. K. Bhattacharyya

Teleradiology, telepathology, and teleoncology are important applications of tele-medicine. Recent advances in these fields include a preponderance of radiology PACS (Picture Archiving and Communications System) users, the implementation of around-the-clock teleradiology services at many hospitals, and the invention of the first ultrarapid whole-slide digital scanner based on the array microscope. These advances have led to the development of a new health-care-delivery clinical pathway called the ultrarapid breast care process (URBC), which has been commercialized as the UltraClinics® process. This process bundles telemammography, telepathology, and teleoncology services and has reduced the time it takes for a woman to obtain diagnostic and therapeutic breast-care planning services from several weeks to a single day. This paper describes the UltraClinics process in detail and presents the vision of a network of same-day telemedicine-enabled UltraClinics facilities, staffed by a virtual group practice of teleradiologists, telepathologists, and teleoncologists.
Kino-University Physicians Hospital
Tucson, Arizona

DMetrix Scanner
Chronic Disease Management
Diabetes Classes to Amado via POTS (phone lines)

Sopori Elementary School
Amado

St. Elizabeth of Hungary Clinic
Tucson

© 2013, Arizona Telemedicine Program
Diabetes Monitoring

- 8 Megapixel Camera (60% more pixels than previous iPhone)
- New advanced optic lens to enhance shape and light
- Face detection
- 1080p Video Recording
- iOS5
- SIRI voice activation
- Dual core chip – more power, less battery usage
Mobile App: PTSD Coach

PTSD Coach mobile app wins FCC award for helping people use technology to manage PTSD symptoms.

The PTSD Coach app can help you learn about and manage symptoms that commonly occur after trauma. Features include:

- Reliable information on PTSD and treatments that work.
- Tools for screening and tracking your symptoms.
- Convenient, easy-to-use skills to help you handle stress symptoms.
- Direct links to support and help.
- Always with you when you need it.

Download the mobile app
Free PTSD Coach download from: iTunes (iOS)® and Google Play (Android)®
Telemedicine Training

© 2010, Arizona Telemedicine Program
It's been a great 20 years.

Now a patient in a rural community can benefit from immediate access to highly trained specialists who can diagnose the patient's cardiac or respiratory condition or stroke as rapidly – and as accurately – as if the patient and specialist were in the same room. This report will give you a look at some of Arizona’s outstanding telemedicine programs.

For example:
- A tele-echo cardiography system in Yuma Regional Medical Center’s neonatal ICU, enabling rapid diagnosis of critical cardiac conditions in newborns (Page 9).
- A nationally recognized distance learning program for physicians, nurses, and other health professionals (Page 12).
- Flagstaff Medical Center’s long-distance monitoring program for patients with congestive heart failure – including patients without electricity in their homes (Page 20).
- A telespeech pathology program for Native Americans that provides early detection and treatment for diabetic retinopathy, reducing medical costs for people who lose their sight (Page 23).
- The telestroke program started by the Mayo Clinic – Scottsdale and the Arizona Department of Health Services, which has equaled stroke care at small rural and larger urban hospitals (Page 26).
- The Banner Health electronic Intensive Care Unit, which links a two-way audio/video monitoring system in every ICU patient room to a remote team of nurses and doctors who back up the ICU staff (Page 26).

Robert “Bob” Burns
Co-Founder, Arizona Telemedicine Program Chair, Arizona Telemedicine Council

Ronald S. Weinstein, MD
Co-Founder and Director

Arizona Telemedicine Program Staff

Arizona Telemedicine Program, University of Arizona Health Sciences Center, Tucson, Arizona

Phone: 1-877-533-6166 • www.telemedicine.arizona.edu
The T-Health Institute was established by the University of Arizona, in 2003, as a Phoenix division of the Tucson-headquartered Arizona Telemedicine Program. Located on the Phoenix Biomedical Campus in downtown Phoenix, T-Health’s mission is to offer telemedicine and telehealth training programs and to create “next-generation” innovations in education and health-care delivery, especially those that leverage advances in medical informatics, wireless telecommunications, telemedicine/telehealth, simulation, and robotics. Ronald S. Weinstein, MD, is the founding director of the Arizona Telemedicine Program and executive director of its T-Health Institute.

The T-Health Institute’s international award-winning T-Health Amphitheater was designed by Dr. Weinstein and former executive director of Biomedical Communications Richard McNeely. It serves as a University of Arizona College of Medicine "a- Classroom of the Future." Experimental education programs, including an innovative medical science curriculum for K-12 students and Interprofessional Education and Practice (IPEP) exercises, are tested in the T-Health Amphitheater. Staff at the T-Health Institute also are engaged in translational research on the development of a next generation of clinical decision support systems. The focus of interest is the acute management of traumatic brain injury and sudden cardiac death. This is to support the Arizona Emergency Medicine Research Center — Phoenix.

Arizona Corporation Commissioner Burns, Arizona Senator Gail Griffin, Dr. Weinstein, Stuart Flynn, MD, dean of the UA College of Medicine — Phoenix and Steven Goldschmidt MD, dean of the UA College of Medicine — Tucson watch as Governor Jan Brewer signs the Telemedicine Reimbursement Parity Act into law in the T-Health Amphitheater on the campus of the University of Arizona College of Medicine — Phoenix. This bill requires telemedicine services in rural areas of Arizona to be covered by health insurance. Beginning in 2015, insurers must cover services provided through telemedicine service programs if the insurers pay for those same services when they are provided in a traditional clinic or hospital setting.

Governor’s ceremonial signing of Senate Bill 1353 in the T-Health Amphitheater on the University of Arizona College of Medicine — Phoenix campus.

T-Health Institute — a Division of the Arizona Telemedicine Program

The University of Arizona College of Medicine — Phoenix auditorium building housing the T-Health Institute.