Bringing Back the House Call: a Telemedicine Solution

Redefining Medicine With Apps and iPads

From First Science Page

middle finger of his right arm.

one by one, each trainee took a turn. An X-ray or echocardiogram would do the job more accurately, but Dr. Heineken wanted his students to experience discovering an enlarged heart in a physical exam.

Dr. Heineken fills his teaching days with similar lessons, which can mean struggling upstream against a current of technology. Through his career, he has seen the advent of CT scans, ultrasounds, MRI’s and countless new lab tests. He has watched peers turn their backs on patients while struggling with a new computer system, or rush through appointments while forgetting the most fundamental tools — their eyes and ears.

For these reasons, he makes a point of requiring something old-fashioned of his trainees.

“Tell them that their first reflex should be to look at the patient, not the computer. Dr. Heineken said. He told the team to return to each patient’s bedside at day’s end. “I say, ‘Don’t go to a computer; go back to the room, sit down and listen.’ It’s a lot like you’re in a bar.”

The reason is none. Dr. Heineken, said, is to adjust treatment recommendations based on the patient’s own priorities. Any difficult clinical decision is made easier after discussing it with the patient.

It is no surprise Heineken opposes digital technology. Dr. Heineken has been using the Department of Veterans Affairs’ computerized patient record system since it was introduced 15 years ago. Still, his entire chart is an old, flip model, and he experiences with text messaging is limited.

His first appointment one recent day was with Eric Conrad, a 49-year-old veteran soldier with severe emphysema. First came a conversation. Dr. Heineken had his patient sit at a chair next to his desk. Dependent, the patient looked down at his battered Breadless, his breaths shallow and labored.

Dr. Heineken has been seeing Mr. Conrad since 1993, and since then, he said, “we’ve been fighting a saw-tooth battle with his weight.”

In an instant, the computer generated a graph showing the jagged history of weight successively gained, then lost. Dr. Heineken pointed the computer screen to the patient, saying: “It’s a weight gain in recent months. “It’s looking a lot better than it has,” he said. Mr. Conrad’s face brightened slightly.

Concerns about losing the tradition of hands-on care.

Then Dr. Heineken turned his back to the computer and sat as close to the patient that they were knee to knee. Mr. Conrad delved his gaze into his physician’s eyes, looking for answers.

It was not until Dr. Heineken was ready to listen to Mr. Conrad’s lungs that he asked him to move to the examining table.

“I love him to death,” Dr. Conrad said. “He’s right to the point, good news or bad news.”

The rate of change and a technological revolution separate Dr. Heineken from Dr. Rajkomar.

The son of an electrical engineer from Manhattan, Anirban Rajkomar grew up in Silicon Valley and taught himself to program at age 12. As an undergraduate at Harvard, he started out in physics but became hooked on medicine in Mauritius, where he spent a few days a year summering his uncle, a physician at a community clinic.

“There were no fancy medications or procedures,” he said. “Just the art of medicine.”

In 2003, in his third year of medical school at Columbia, he was among the first to hospitalise an iPad as a clinical tool. “Every time you looked something up you’d get sidetracked,” he said. “At that point, people believed that if you had your phone out you weren’t working.”

Among the new crop of device-smart physicians, Dr. Rajkomar is now an eminence grise, showing how — in using his favorite apps, along with shortcuts through the electronic medical record and computerized prescribing systems. He stores every clinical nugget he learns on an application called Evernote, an electronic filing cabinet. “I use Evernote as a second brain,” he said. “I now have a small library of personalized, auto-indexed clinical pearls that I carry with me all the time on my iPhone.”

Along with MedCalc, the clinical calculator, Dr. Rajkomar’s phone has ephemerides, an app for looking up drug dosages and interactions; and Pros Calcul, which he uses to create risk profiles for his patients. His favorite tech — an electronic stethoscope, which amplifies heart sounds while containing an auditory system.

Not that he is indignant in use of technology. When he decided electronic health record was taking too long to load on his iPad, he went back to taking notes by hand, on paper. But he is experimenting with writing by hand on a Samsung mini-tablet.

He is aware of the pitfalls of computerized records, particularly the “If the problem is X, then do Y” templates, which encourage a cut-and-paste approach to daily progress notes. While effective, they can give rise to robotic bookkeeping without regard to how the patient is feeling.

Tablet computers that are linked to electronic health records are making their way into the hands of medical trainees across the country. All internists-medical residents at the University of Chicago and Johns Hopkins are given iPads; entering medical students at Stanford are given vouchers they can use to buy one.

A University of Chicago study this year in Archives of Internal Medicine found that residents with iPads were able to enter orders in a more timely manner, and a majority of residents reported that the iPad improved their work efficiency. At the U.C.S.F. Medical Center, some physicians use iPads, and many use one of the hospital’s computers on wheels.

Dr. Rajkomar’s outpatient clinic in four miles west of the U.C.S.F. hospital, at the San Francisco V.A., where he works down the hall from Dr. Heineken. Where Dr. Heineken is competent with the V.A.’s electronic health record system, Dr. Rajkomar is a virtuoso, a Vladimir Horowitz of the computer keyboard. He can keep his eyes fixed steadily on the patient while the typing goes all but unnoticed.

As the conversation with the patient goes, so goes Dr. Rajkomar’s interaction with the computer. Lab results? On the screen in a flash. A list of past and current medications and diagnoses? Voila! Yet he always knows when the computer needs to set aside. During a visit, when a patient confessed that his wife was taking his pain medication, Dr. Rajkomar excused himself and walked down the hall to consult with the pharmacist about a plan to keep that from happening.

Dr. Rajkomar knows he has a great deal to learn about being a physician, especially patients’ social and psychological complexion.

“One patient fired me,” he said. “Smiling as he added, ‘Dr. Heineken gets those patients.”
With Telemedicine as Bridge, No Hospital Is an Island

BY PAM BELLUCK

NANTUCKET, Mass. — When Sarah Cohen’s 6-year-old drover to visit a dermatologist in July, that’s what she figured she’d be doing — visiting a dermatologist. But at the hospital on Nantucket, where her family spends summers, Ms. Cohen, 19, was perplexed.

“I thought I was going to see a regular doctor,” she said, but instead she saw “this giant screen.”

Suddenly, two doctors appeared on the video screen: dermatologists in Boston. A nurse in the room with Ms. Cohen held a magnifying camera to her face, and suggested she close her eyes. Why? She wondered — then understood. The camera transmitted images of her face on screen, so the doctors could eyeball every blemish and crater. “Oh my God,” she thought. “I was going to cry,” Ms. Cohen recalled. “Even if you’ve never seen that pimple before, it’s there.”

That, she realized, was the point. Technology, like these cameras and screens, is making it affordable and effective for doctors to examine patients without actually being there.

More hospitals and medical practices are adopting these techniques, finding they save money and for some patients work as well as flesh-and-blood visits.

“There has been a shift in the belief that telemedicine can only be used for rural areas to a belief that it can be used anywhere,” said Dr. Peter Yellowlees, director of the health informatics program at the University of California, Davis, and a board member of the American Telemedicine Association. “Before, you had to make do with poor-quality or buy a very expensive system. Now, you can buy a $1000 webcam and do high-quality videoconferencing.”

The technology is especially being embraced by professions like ophthalmology, psychiatry and dermatology, which face shortages of physicians. At Kaiser Permanente, dermatologists “sit in a suite in San Francisco” and tele-treat patients throughout Northern California, Dr. Yellowlees said. “It’s much more efficient than having 20 hospitals, each with a dermatologist.”

On Nantucket, an island 30 miles from the nearest spit of mainland, “telemedicine just makes a lot of sense,” said Dr. Margot Hartmann, chief executive officer of Nantucket Cottage Hospital. “It allows us to have the mission of the hospital better because we’re offering more services,” and saves patients the cost and time of flying or ferrying off-island, then driving to Cape Cod or Boston hospitals.

The island may be small but it’s strikingly diverse medical needs. Its year-round population of about 10,000 balloons to 50,000 in the summer. And while it is famous for wealthy visitors, its year-rounders are much less affluent. They include immigrants from many countries, and range from businesspeople to scallopers.

Nantucket has all the ailments one would find anywhere, plus some exacerbated by island life: skin cancer, tick diseases, water accidents.

“Most people are within an hour of some major hospital,” said Joanne Busdong, the hospital’s outpatient clinic coordinator. Not Nantucket. “We’re not practicing rural medicine; we’re practicing island medicine.”

Nantucket’s hospital has a handful of year-round doctors. While mainland specialists do visit, fog or storms can keep them from getting there. And specialists cost money. The hospital, millions in the red in recent years and now needing $60 million to replace its outdated 1957 building, must pay for the specialists’ travel and lodging.

Telemedicine, done by doctors at Massachusetts General Hospital, saves some of those costs, and generates revenue because it means more tests are done on Nantucket. “If someone was going off-island to see a dermatologist, they would probably have their labs and X-rays done, where that dermatologist was,” Dr. Hartmann said. Instead, tele-dermatology saves nearly $20,000 a year because two dermatologists now visit only four times a year, but appear on screen six times a month and see 1,000 patients a year. Previously, dermatologists visited monthly, and always had “100 people on the waiting list,” Ms. Bushong said.

Nantucket also uses tele-radiology, having Boston radiologists, some specializing in certain body areas, read X-rays and scans. It has used tele-podiatry twice, for a child in a car accident and one in diabetic crisis. Tele-stroke uses video neurologists to quickly determine if a patient’s stroke type warrants a clot-busting drug, TPA, or if TPA could harm the patient.

Tele-endocrinology, for thyroid problems and diabetes, is starting. And Nantucket hopes to have video sessions for autistic children “so parents wouldn’t have to take kids with autism off-island, since it’s hard to travel with them and it upsets them,” Ms. Bushong said.

Dr. Hartmann envisions tele-ophthalmology and tele-psychiatry, among other things. Instead of screens in one exam room and the emergency room, “I think it could do a whole lot of tele-medicine-capable,” she said.

But there are limitations, nationally and on Nantucket. Too many patients lack health insurance, and it’s still too expensive to treat everyone. And video images may not be good enough to determine if patients can be treated there or must be flown to Boston.

Still, it’s a start. “There are some people who use the telemedicine and they like it,” said Dr. Peter Schalock, one of the two Mass General dermatologists who treat Nantucketers remotely. He says he has had to get used to diagnosing without feeling a patient’s skin, relying on the nurse, Ms. Bushong, for that. “Sometime you just need to see someone to tell them they can do it in 10 or 15 minutes myself, when it might take half an hour with the camera. Definitely people with more interesting moles, I like to see myself.”

Still, “we’re pretty good at picking up what looks funny, to use a technical term,” Dr. Schalock said. “I really feel like we’re providing essentially the same quality care.”

So, in August Dr. Schalock remotely diagnosed eczema in Aaron Balazs, 35, but saw him in person in September and increased his medication dosage and switched him from a cream to pills.

Mr. Balazs, stationed on Nantucket with the Coast Guard, was not expecting video doctoring, and said initially “it was sort of awkward.” But he concluded “it’s definitely beneficial in the short term.”

By the time Ms. Cohen had her second session in August, this time with Dr. Schalock, she said, “I feel like it’s the same thing” as an in-person visit. She had accepted the megamagnifying camera by then.

“It kind of freaks out some people,” Dr. Schalock said. “They say, ‘Oh my God, I should have shaved my legs!’ I’m not looking at the hair. I’m looking at the mole.”

Pam Belluck is a Times health and science reporter and author of “Island Practice” (PublicAffairs, 2012), about Dr. Lepore’s experiences.
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 Governor’s Association
Telemedicine Action Report
1995

“Western Governors are committed to improving access to and quality of health care for people living in the rural west.”
Infrastructure Planning & Development
Telecommunications Regulation
Reimbursement for Telemedicine Services
Licensure & Credentialing
Medical Malpractice Liability
Confidentiality
Founded in 1996, funded by the Arizona State Legislature

>1.3 Million Cases
Telemedicine Services

- Telemedicine Infrastructure
- Professional Education
- Telemedicine Assessment
- Telemedicine Training
Arizona Telemedicine Council

AZ - Joint Legislative Budget Committee
Quarterly Meetings since 1996
160+ Sites

- Urban & rural hospitals
- Native American healthcare
- Prisons & jails
- Community health centers
- Schools
- Distance learning affiliates
- International Sites
Today - 55 Health Care Organizations

First Arizona Telemedicine Program Users Group Meeting (1997)
Telemedicine Services
Teleradiology
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<th>Anesthesiology</th>
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<td>Peds. Oral Surgery</td>
<td>Wound Management</td>
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The Provision of Medical Care

- Clinical care
- Evaluation/research
- Continuing education
Who are the Referring Clinicians?

• General
  • MD/DO/PhD/DDS
  • NP/PA
The Clinic Structure

- Hub Site
  - Medical Director
  - Site Coordinator
- Spoke Site
  - Medical Director
  - Site Coordinator
- Referring Clinicians
Scheduling: Real-Time and Store-Forward

- Teleclinic Appointment
- Ad Hoc Appointment
The Teleclinics

- Psychiatry
- Rheumatology
- Pain Clinic
- Cardiology
- Dermatology
Telemedicine Protocols

- Pulmonary
- Cardiology
- Neurology
- Musculoskeletal

- Psychiatry
- Dermatology
- General Medicine
How does a medical consultation become a telemedicine consultation?
Goals of Teleconsultation

- Increase access to specialty care
  - rheumatology
- Confirm diagnosis
  - polymyositis
- Assist in triage
  - cervical spine injury
What makes a good teleconsultation?

- Complete data
  - Avoid the incomplete consult!
- Diagnostic images
- Steps in review:
  - Site Coordinator
  - Medical Director
  - Specialist
Telemedicine Consultation

- Visual specialties
  - ie range of motion
- Technology provides images/sounds
  - echocardiography
- “The talk is the treatment”
  - telepsychiatry
Visual specialties

- Rheumatology
- Orthopedics
- Dermatology
- Neurology
The Joint Exam
Teledermatology
Teledermatology
Teleneurology
Technology provides images/sounds

- Cardiology
- Pulmonary
- Otorhinolaryngology
- Retinal screening
- Colposcopy
- Radiology
- Pathology
Tele-echocardiography
Teleophthalmology
Teleophthalmology
Teleradiology
Fetal Ultrasound
Fetal Ultrasound
Telemammography
Telepathology
"The talk is the treatment"

- Psychiatry/psychology
- Genetic Counseling
- Pain Management
- Nutrition
- Support group
- Hospice care
Telepsychiatry
Telepsychiatry
Infectious Disease
Tele-Urgent Care

- **Teletrauma** - University of Arizona Health Network (multiple communities)
- **Telestroke** - Mayo Clinic Telestroke Network (11 rural communities)
- **Teleburn** - Arizona Burn Center (Maricopa Medical Center – 12 Sites)
- **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
Southern Arizona Teletrauma & Telepresence Program (SATT)

Tucson
Benson
Sierra Vista
Sells
Nogales

Whiteriver
Safford
Wilcox
Bisbee
Douglas

© 2010, Arizona Telemedicine Program
Stroke telemedicine network at Mayo Clinic in Arizona

Mayo Clinic in Phoenix, Ariz., serves as the hub for several remote locations in a stroke telemedicine network.
eICU (7 Banner Hospital Network)

Banner Health “Electronic Intensive Care Unit”
Telemedicine for Trauma, Emergencies, and Disaster Management

Tele-urgent care

Teletrauma

Telestroke

Teleburn

eICUs
Health Care System

- Teleconsultation system in:
  - Hospital
  - Community health center
  - Office practice
  - The Home
Home Health Care Applications

- Wound care
- Post-operative care
- Pre-organ transplantation
- Physical therapy
Tele-Home Health
Wound Management
Tele-Home Health

Blood Glucose Monitor

Central Nurses Station

© 2013, Arizona Telemedicine Program
... waiting for a donor heart
Telemedicine Services
Telepresence
Preparedness
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
Telepresence
Memorial on front lawn, University Medical Center
Tucson, Arizona
Newest Health Care Tool
Medical Self-monitoring
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
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
Arizona Telemedicine Program

Venues

- **Tucson** - AHSL & Telemedicine Clinics
- **Phoenix** - T-Health Amphitheater & TM Clinics
- **Regional** - Southwest TRC, Webinars, eLearning

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Arizona Telemedicine Training Program

The Arizona Telemedicine Training Program provides instruction in the many aspects of running a telemedicine program.

The Arizona Telemedicine Training Program offers two full-day training sessions and is accredited by the American Telemedicine Association.

Register Now!

TRACK 1 - Developing a Telemedicine Program:

2013 Dates: January 7th; May 13th; and September 16th.

This conference is designed to give a broad overview of a variety of telemedicine topics to include:

- Clinical services
- Telecommunications and infrastructure development/operations
- Distance education
- Evaluation
- Business aspects
- Equipment demonstration

TRACK 2 - Telemedicine Applications:

2013 Dates: March 11th; July 15th; and November 4th.

This conference offers a more detailed approach for any telemedicine program, providing a more in-depth look at the clinical applications of a telehealth program. This conferences are excellent for individuals or groups who have some telehealth experience and are interested in expanding their services. It's also a great course for those new to telehealth who are interested in understanding this growing industry.
Online Education: Video Library

Click here to take our quick survey and receive a user name and password to access the videos below. Then click on the title to start the video.

If you already have your username and password, click here to login.

**SWTRC Services**
- Full Day Training Programs
- Online Learning Modules
- Help Desk
- Technical Assistance
- Tools & Templates
- Program Development
- Business Matrix
- Evaluation
- Risk Involves
- Clinical Operations
- Sustainability
- Equipment Recommendations
- Importance Overview

**Telemedicine and Telehealth Overview**
- The history, progression, and current uses of telemedicine and telehealth.

**Clinical Applications Overview**
- Clinical services (real-time and store-and-forward) that have been enabled by telemedicine consultation and how these services can help underserved areas.

**Telecardiology**
- Definition of telecardiology services, requirements to provide this service, and current applications.

**Teledermatology**
- Definition of teledermatology services, requirements to provide this service, and current applications.

**Telemonitoring**
- How telemonitoring can help close the nursing shortage gap. Case studies are presented and outcomes results are discussed.

**Telepathology**
- Definition of telepathology services, requirements to provide this service, and current applications.

**Telepsychiatry**
- Definition of telepsychiatry services, requirements to provide this service, and current applications.

**Teleradiology**
- Definition of teleradiology services, requirements to provide this service, and current applications.

**Teletrauma**
- Definition of teletrauma services, requirements to provide this service, and current applications.

**Case Study Process**
- Go through the steps required to set up a telemedicine/telehealth facility, including placement of the equipment, lighting, wall color, etc.

**Video and Data Communication**
- Basic introduction to networking and data communications. Description of the Internet, local area networks, dial-up, asynchronous and video communication modes (e.g., Internet, satellite, microwave), including the advantages and disadvantages of each as they relate to teledermatology.

**Telemedicine/Telehealth Network**
- Overview of how a telemedicine/telehealth network is set up and the roles of various pieces of equipment (e.g., CODEC, MCU, computer applications (e.g., videoconferencing, Skype), video bridges, gatekeepers, and communication protocols (e.g., H.323).

**Culture, Etiquette & Technology**
- The impact of technology on social interaction and the universal rules of good manners and technology.

**Information Services**
- The importance of information resources available to healthcare professionals and consumers, as identified by university-based librarians.

**Challenges & Barriers**
- The challenges and barriers to implementing a successful telemedicine/telehealth program and lessons learned from successful programs.
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Strategic Planning
New drivers creating need for virtual care models (ACO, PPACA, 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
Telehealth Issues & Opportunities

New drivers creating need for virtual care models (ACO, PPACA, 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
“Killer” applications

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

A- Gap Services – (i.e., teleradiology)

B- Urgent Services – (i.e., telestroke)

C- Mandated Services – (i.e., prison telemedicine)
Telesstroke Networks

The American Heart Association/American Stroke Association (AHA/ASA) recommends the use of telemedicine, or telesstroke, to improve stroke care in rural, remote, or underserved areas.¹¹

Discover how telesstroke allows for specialized stroke care in underserved areas.

- **What Is Telesstroke?** Learn about the different telesstroke models.
- **Key Elements of a Telesstroke System** Find out about equipment, challenges, and best practices associated with telemedicine.
- **Telesstroke Resources** Explore resources on telesstroke.
- **Telesstroke Network Map** View telesstroke networks on a national scale.

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Education and Training

- **HealthStream**
  - Free access to educational materials and training on acute ischemic stroke and Activase for your stroke center.
  - Learn More

Dosing and Administration

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

Register for Updates

- **Register Now**
  - Receive updates and gain free access to order educational resources.

---

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).
Commercialization

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.

and transportation barriers with reliable technology that allows immediate access to stroke experts who can provide consultation with on-site providers to manage acute stroke as needed.

Keep stroke patients close to home.

With TeleStroke, community hospitals can provide stroke care to

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**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

**TELESTROKE DOCTOR**

A. 24-7 on-call TeleStroke doctor receives call or page
B. Doctor begins video conferencing and evaluates patient data
C. Exam given via TeleStroke system to evaluate presence or severity of stroke
D. 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.

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.
CT Interpretation in a Telestroke Network
Agreement Among a Spoke Radiologist, Hub Vascular Neurologist, and Hub Neuroradiologist

Bart M. Demaerschalk, MD, MSc; Bentley J. Bobrow, MD; Rema Raman, PhD; Karin Ernstrom; Joseph M. Hoxworth, MD; Ameet C. Patel, MD; Terri-Ellen J. Kiernan, MSN; Maria I. Aguilar, MD; Timothy J. Ingall, MD, PhD; David W. Dodick, MD; Brett C. Meyer, MD; for the Stroke Team Remote Evaluation Using a Digital Observation Camera (STRokE DOC) in Arizona—The Initial Mayo Clinic Experience (AZ TIME) Investigators

Background and Purpose—The American Stroke Association guidelines emphasized the need for further high-quality studies that assess agreement by radiologists and nonradiologists engaged in emergency telestroke assessments and decision-making. Therefore, the objective of this study was to determine the level of agreement of baseline brain CT scan interpretations of patients with acute stroke presenting to telestroke spoke hospitals between central reading committee neuroradiologists and each of 2 groups, spoke hospital radiologists and hub hospital vascular neurologists (teleskroktologists).

Methods—The Stroke Team Remote Evaluation Using a Digital Observation Camera Arizona trial was a prospective, urban single-hub, rural 2-spoke, randomized, blinded, controlled trial of a 2-way, site-independent, audiovisual telemedicine and teleradiology system designed for remote evaluation of adult patients with acute stroke versus telephone consultation to assess eligibility for treatment with intravenous thrombolysis. In the telemedicine arm, the subjects’ CT scans were interpreted by the hub teleskroktologist and in the telephone arm by the spoke radiologist. All subjects’ CT scans were subsequently interpreted centrally, independently, and blindly by 2 hub neuroradiologists. The primary CT outcome was determination of a CT-based contraindication to thrombolytic treatment. Kappa statistics and exact agreement rates were used to analyze interobserver agreement.

Results—Fifty-four subjects underwent random assignment. The overall agreement for the presence of radiological contraindications to thrombolysis was excellent (0.91) and did not differ substantially between the hub teleskroktologist to neuroradiologist and spoke radiologist to neuroradiologist (0.92 and 0.89, respectively).

Conclusions—In the context of a telestroke network designed to assess patients with acute stroke syndromes, agreement over the presence or absence of radiological contraindications to thrombolysis was excellent whether the comparisons were between a teleskroktologist and neuroradiologist or between spoke radiologist and neuroradiologist.

Clinical Trial Registration—URL: http://www.clinicaltrials.gov. Unique identifier: NCT00623350.
(Stroke. 2012;43:3095-3097.)

Key Words: computed tomography ■ randomized controlled trials ■ rural health ■ rural hospitals ■ stroke ■ telemedicine ■ telestroke
Figure 1. A, Photograph depicting the bedside National Institutes of Health Stroke Scale (NIHSS) assessment scenario. B, Photograph depicting the remote NIHSS assessment scenario. Photographs portray Mayo Clinic employees, not patients. Dr Vargas (A) and Dr Demaerschalk (B) are the bedside and remote neurologists, respectively. Ms Vegunta is the medical aide and Ms Psket (medical practice secretary) volunteered to portray the part of the patient with stroke. Photographs by Mayo Clinic Media Support Services Photography.
Reliability of Real-Time Video Smartphone for Assessing National Institutes of Health Stroke Scale Scores in Acute Stroke Patients

Bart M. Demaerschalk, MD, MSc, FRCP(C); Sravanthi Vegunta, BS; Bert B. Vargas, MD; Qing Wu, ScD; Dwight D. Channer, MS; Joseph G. Hentz, MS

Background and Purpose—Telerestroke reduces acute stroke care disparities between urban stroke centers and rural hospitals. Current technologies used to conduct remote patient assessments have high start-up costs, yet they cannot consistently establish quality timely connections. Smartphones can be used for high-quality video teleconferencing. They are inexpensive and ubiquitous among health care providers. We aimed to study the reliability of high-quality video teleconferencing using smartphones for conducting the National Institutes of Health Stroke Scale (NIHSS).

Methods—Two vascular neurologists assessed 100 stroke patients with the NIHSS. The remote vascular neurologist assessed subjects using smartphone videoconferencing with the assistance of a bedside medical aide. The bedside vascular neurologist scored patients contemporaneously. Each vascular neurologist was blinded to the other’s NIHSS scores. We tested the inter-method agreement and physician satisfaction with the device.

Results—We demonstrated high total NIHSS score correlation between the methods ($r=0.949; P<0.001$). The mean total NIHSS scores for bedside and remote assessments were 7.93±8.10 and 7.28±7.85, with ranges, of 0 to 35 and 0 to 37, respectively. Eight categories had high agreement: level of consciousness (questions), level of consciousness (commands), visual fields, motor left and right (arm and leg), and best language. Six categories had moderate agreement: level of consciousness (consciousness), best gaze, facial palsy, sensory, dysarthria, and extinction/inattention. Ataxia had poor agreement. There was high physician satisfaction with the smartphone.

Conclusions—Smartphone high-quality video teleconferencing is reliable, easy to use, affordable for telerestroke NIHSS administration, and has high physician satisfaction. (Stroke. 2012;43:3271–3277.)
Sustainability Issues

- “Meaningful use”
- Reimbursement
- Credentialing
- Interstate medical licensure
- Telecommunications costs
- Equipment obsolescence
Cross-Cultural Issues
Limitations
Virtual Reality Palpation
The Future is Now!
Thank you

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