



# THE DOCTOR IS ALWAYS IN

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*By taking advantage of broadband connectivity, health services can be made available without borders or time zones. And with the virtually unlimited bandwidth of fiber to the home, telehealth's only limit may be that of imagination.*

Telemedicine, strictly defined, is the use of telecommunications to provide medical information and services, and can range from two doctors talking on the phone about a patient's care to use of robotic technology to perform surgery remotely. In recent years, the idea has expanded to encompass a variety of health services and not solely the direct provisioning of clinical care by a physician or nurse. This wider scope of virtual services delivery is more commonly called "telehealth" or "e-health."

Telehealth offers a number of benefits and few downsides (see Figure 1). And while an aging baby boomer population and a shortage of qualified personnel in the healthcare industry have elevated interest in telehealth in recent years, according to the Telemedicine Information Exchange (TIE), telemedicine has been in practice for more than 40 years.

The Nebraska Psychiatric Institute is credited as one of the earliest, one of the first facilities in the United States to use closed-circuit television as a method for linking the institute in real-time with the Norfolk State Hospital 112 miles away. Begun in 1955, this link was used for staff education as well as consultations between general practitioners and specialists, and was eventually expanded to include three Veterans Association facilities in other Nebraska towns.

Many of telemedicine's advances, according to TIE, were pioneered in the early 1960s by the National Aeronautics and Space Administration (NASA), which needed to monitor the physiological welfare of astronauts in orbit. NASA provided much of the early funding and research

## Figure 1:

### Telehealth Benefits:

- Makes specialty care more accessible to underserved populations
- Instant access to information and "tele-assistance" from specialists can save lives and increase the accuracy of diagnoses
- Home healthcare providers can "see" more patients per day and work more efficiently, enabling more services to be provided at home more frequently
- Eliminates travel for patients who may find it difficult and/or costly to do so
- Can reduce the cost of healthcare provisioning

### Challenges Facing Telehealth:

- With few exceptions, Medicare and private insurance companies not ready to pay for most "virtually" delivered health services
- Most states won't allow out-of-state physicians to practice

and development in telemedicine applications and devices in the U.S., including the Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) program in remote Arizona. A van staffed by two paramedics served the Papago Indian Reservation with a variety of medical equipment, including an electrocardiograph and X-ray. The van was linked via two-way microwave and audio transmission to two hospitals.

At about the same time, NASA conducted research on the minimal video resolution and quality requirements for reliable telediagnosis – 200 lines or higher and at least 10 frames per second as of 1974 – and about 15 years later, NASA was responsible for the first international telemedicine program. The Space Bridge to Armenia was developed between the United States and former Soviet Union to provide medical diagnoses via video, voice and facsimile from U.S. hospitals to a medical center in Yerevan, Armenia, after a massive earthquake there. The service was soon extended to Ufa, Russia, after a devastating railway accident.

Again, these early telemedicine examples primarily focused on providing direct clinical care by a physician, typically of a more urgent nature and often to underserved locations and populations. That is still true today, but the nature and scope of service delivery has expanded far beyond the early telemedicine model as broadband connectivity has increased.

Today, advances in telehealth are enabling specialized, preventative healthcare, real-time diagnoses of life-threatening cases, and management of chronic illnesses, all regardless of location.

### **Addressing Urgent Needs and Underserved Populations**

There is no doubt that the Internet has played a significant role in the growth and awareness of telehealth. According to a May 2004 article at InformationWeek.com, the top use of the Internet among all age groups is to search for health information. But today's telehealth goes beyond static websites with lists of symptoms and message boards full of fellow "netizen" researchers.

Crisis care, preventative care and disease management are all being delivered virtually by physicians and other medical personnel:

#### *Childrens Hospital Los Angeles' Virtual Pediatric Intensive Care Unit*

Critically ill children who end up in the emergency rooms at five Southern California hospitals are examined by pediatric emergency physicians at the Childrens Hospital Los Angeles (CLHA) as part of its Virtual Pediatric Intensive Care Unit. But the examinations are performed virtually, with sophisticated telemedicine units and a high-speed T-1 network routing high-quality video, audio and data to and from the facilities. Each telemedicine cart at the remote hospitals is equipped with a monitor, a stethoscope, otoscope with camera, and a camera for X-rays and tests; nine receiving units within CLHA allow pediatric critical-care specialists up to 100 miles away to evaluate the patient, interact with both the patient and attending physicians, and recommend courses of treatment.

without a license from their own state

- Lack of broadband connectivity, particularly in remote and/or poorer regions, limits robust telehealth applications (video streaming, real-time monitoring, etc.)
- The paradigm shift for medical personnel is being slowed by concerns about malpractice liability, and discomfort with, or distrust of, the technology

### *Asthma Management for San Francisco Students*

In San Francisco, telehealth is being used to provide ongoing care to elementary school students; it was estimated that up to 30 percent of the total student population in the city suffered from asthma but had little to no treatment plans for management of this chronic condition, particularly in low-income areas. Asthma experts at the Lucile Packard Children's Hospital teamed up with the San Francisco school district to deliver specialized asthma care to students living in the largely low-income, African-American community of Bayview Hunters Point, where asthma rates were twice the national average. Specialists at the hospital evaluate students remotely via real-time video consultation and create a personalized treatment plan. The specialists "meet" with the students several times per year via video to review patient progress and provide follow-up instructions.

### *State University of New York – Syracuse Virtual Pathology*

A 15-year-old boy diagnosed with a brain tumor was on the operating table at the Wilson Hospital in Binghamton, New York, when neurosurgeons discovered the tumor was significantly different from what was expected. A second opinion from a neuropathologist was needed, but the nearest specialist was located at the State University of New York (SUNY) - Syracuse, 80 miles away. Had the two hospitals not been linked as part of a telemedicine initiative, the patient would have had to wait for at least two days, and undergone a second surgery, while tissue samples were sent upstate and consultations performed. Instead, the tissue was placed under a high-power microscope in Binghamton, linked to the SUNY-Syracuse hospital, and the neuropathologist recognized the growth as a rather rare tumor type with a specific course of treatment, which could begin immediately.

### *Northwest Arctic Borough of Alaska's Telehealth Network*

Eleven remote villages located above the Arctic Circle in Alaska, with a total population of about 7,600, use the comparably larger town of Kotzebue (population 3,082) as their regional medical center. The area is remote – Kotzebue is the nearest large town for these villages and yet 100-200 miles away from them – with no roadways connecting them and accessibility only possible via aircraft or boat as weather permits. These villages are connected to Kotzebue via a telecommunications network, with community health practitioners (similar to emergency medical technicians) stationed in each village. Kotzebue is similarly connected to Anchorage.

In the past, patients who needed immediate treatment had to travel to Kotzebue via Medivac, weather permitting. Now, real-time video and audio are making critical care possible in the villages: one woman in Kotzebue with an ectopic pregnancy would have died without surgery, yet severe weather made travel to the nearest hospital in Anchorage impossible. The doctor at Kotzebue's medical center performed the surgery through a real-time video consult with a surgeon in Anchorage. In another case, when a young villager punctured his cheek in a four-wheeler accident, the health practitioner in the village was able to suture the wound, guided by a specialist hundreds of miles away via real-time digital imaging. Without the telehealth network, the boy would have had to have been transported an hour by plane to the nearest facility, a more traumatic experience and far more costly for his parents.

## Telemedicine: What's Next

Telehealth is also becoming attractive as a method for delivering home-based health services, as the post-World War II baby boomer generation ages; according to InformationWeek.com, U.S. spending on healthcare will grow faster than the total economy and will account for 18.4 percent of the gross domestic product by 2013. Simultaneously, there is a shortage of physicians and nurses in the U.S. Add to that a growing awareness of the cost of healthcare delivery and consumers who demand greater service and convenience for the price, and home telehealth services could become a significant new market in the future.

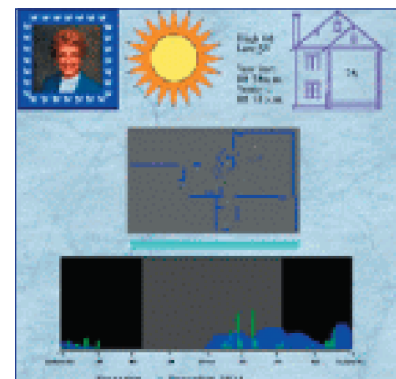
Home healthcare is already taking advantage of the immediacy and convenience that telehealth can provide. Home-health nurses are taking digital pictures of their patients' wounds and incisions and transmitting them to specialists, eliminating the need for the patient, who is often chronically ill, to travel to the hospital to be checked or, in the case of patients who need to be checked several times per day, having to stay in the hospital. Simultaneously, the specialists can "see" far more patients per day than they would be able to see in person. Programs are also in place to monitor the weight and blood pressure of patients recovering – at home – from heart failure and other heart diseases; patients use wired scales and blood pressure devices that transmit directly to the monitoring center.

Perhaps most intriguing, several universities and private research institutes around the world are exploring the idea of medically "smart" or "aware" homes, which range in scope from apartments that have telehealth medical units built in and connected (such as blood pressure devices, wired scales and video conferencing equipment) to nearly sensate houses that go beyond monitoring their residents to virtually anticipating their needs. The Georgia Institute of Technology's Aware Home Research Initiative is an example of the latter. (To read about The University of Rochester's Smart Medical Home, check out the Broadband Spotlight in this issue of GuideLines® Online.)

Georgia Tech's Aware Home is a 5,000+ square-foot, multistory home designed with people, particularly older adults, in mind. This living laboratory is wired in nearly every conceivable way – floors, walls, furniture, fixtures – to allow constant monitoring of its residents. Should a resident fall and be unable to get up or respond, the house can recognize this and call for emergency services. If the home is becoming dangerously cold, it can identify the reason (a window left open, the thermostat



**Fig 2:** A "gesture pendant" would recognize an inhabitant's gestures and translate them into commands to run appliances, valuable for those with limited mobility or lessened fine motor control.



**Fig 3:** A "digital family portrait" flat panel display would allow family members living far away to get a general sense of how their loved one is doing.

being set too low, etc.) and alert the resident. Telemedicine units in the house would allow residents to check their vital signs, and report them as appropriate to their physician.

The Aware Home is not simply designed as a medical safety net, but instead to serve and support its aging inhabitants in living as independent, healthy and happy a life as possible. For example, the Aware Home includes systems dedicated to “cognitive support,” prompting seniors with reminders of their day-to-day routines, such as taking a prescription medicine at a certain time or closing the living room window at night, or finding lost objects like keys. The house also includes everyday home assistants, such as intuitively designed displays with large buttons to serve as universal remotes and “gesture pendants” (see Figure 2). Finally, the house can be connected, as desired, to loved ones living elsewhere, with a “digital family portrait” (see Figure 3) that would give off-site family members or support personnel general information on the inhabitant’s well-being.

It is believed that, as with computers and other personal electronics in the last few decades, the cost of technologies like those in the smart home will eventually decline to the point where an aware home is financially equivalent to, or even less costly than, an assisted living center or nursing home. What’s clear today is that the applications for telehealth, and the demand for it, will only increase with time.