

Telemedicine: The Bandwidth of the Future

BY THOMAS C. LEE, MD

Communications technology is evolving rapidly. According to Moore's Law, the number of transistors on a computer circuit doubles every 18 to 24 months. This means that devices continually become exponentially more powerful, while at the same time smaller and more affordable. Small and affordable translate to widespread adoption. When this technology is applied to medicine, there is enormous potential to disseminate the best practices to the widest possible audience and effect the greatest positive change in health care.

TELEMEDICINE WITHIN THE UNITED STATES

Pediatric ophthalmology is a stunning example of telemedicine capability bringing a plethora of widespread benefits. Ophthalmic disease is uniquely amenable to telemedicine technology because ophthalmic diagnostics are dominated by ocular images, which naturally lend themselves to being shared. Studies show that unfavorable outcomes from retinopathy of prematurity (ROP), the leading cause of childhood blindness, can be significantly reduced with early diagnosis and treatment.¹ Level 3 neonatal intensive care units (NICUs) in the United States must provide this screening and treatment in order to acquire and maintain their licenses to operate. Within the United States, the need for ROP screening has risen; however, the number of ophthalmologists willing and able to conduct these screenings has declined.

MY EXPERIENCE WITH TELEMEDICINE

Many hospitals that are not equipped to screen and treat neonates have been forced to transfer any newborn weighing less than 1500 g and receiving oxygen (the screening criteria) to another hospital or otherwise be subject to a lawsuit if ROP develops. From 2006 to 2007, the city of Las Vegas lost the screening and treating physician for their four NICUs and faced this same conun-

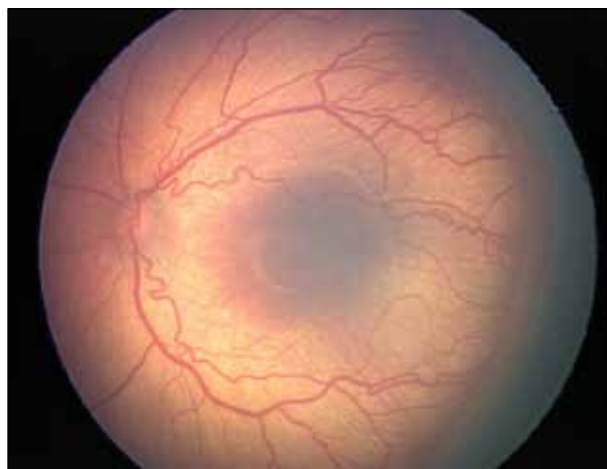


Figure 1. ROP captured by the RetCam 3.

drum. They found a qualified person to screen patients, and I was able to partner with this physician without leaving Los Angeles. The RetCam (Clarity Medical) was used to image the patient, and the files were forwarded (Figure 1). I would discuss them with the attending physician in Las Vegas, and if there was cause to worry, the patient was transferred to Children's Hospital Los Angeles (CHLA) for treatment. For an entire year, we were able to cover all 4 neonatal units in Las Vegas and drastically reduce the number of newborns who had to be medically transported away from their families and support systems.

Within CHLA, we increasingly use telemedicine. Video-enabled slit-lamp adapters are used to stream images over the internet via a Health Insurance Portability and Accountability Act-compliant platform to colleagues at any of our locations. This hospital system includes a large number of world-renowned specialists, and if a patient comes into 1 office and the attending physician has a question, a query can be funneled to anyone within the

network using direct video. This creates the potential for a patient to be evaluated by a physician who is an expert in a particular pathology without the inconvenience of having to travel great distances.

Apart from triage and consultation, the telemedicine program also allows physicians to co-manage stable patients throughout their treatment with another physician or an optometrist. A provision within the California State Medicaid system allows for a telemedicine modifier to the current procedural terminology code, allowing physicians to bill appropriately. The net result is that the patient always gets paired to the specific physician who is best able to treat him or her, truly a benefit for all.

EMPLOYING TELEMEDICINE ABROAD

In the United States, physicians have numerous opportunities for additional training from experts in specialized fields without an unmanageable travel burden. This is not the case in many developing countries, and those who wish to gain expertise in ROP would have to close their practice and move to where they can train for an extended period of time, an expensive proposition. When they return to their home country, these doctors are often under pressure to restrict the patients they see to those who can pay for services.

We have established a distance learning program in Armenia with the Armenian Eye Care Project (AECPP) that is working phenomenally well and enables physicians to gain expertise in ROP without traveling abroad and being saddled with debt, allowing them to provide help to a much wider range of patients. The first stage involves using RetCam images to supervise training of physicians in diagnosing ROP. This has been exceptionally successful, and many Armenian ophthalmologists are now proficient in the diagnosis and management of ROP. In developing countries, the incidence of ROP can be as high as 30% of all preterm births.² Among neonatal patients in the hospitals involved in our training program, that number has been dramatically reduced.

Due to the success of the ophthalmic education platform, the Armenian ministry of health asked us to expand the program to neonatal health care in general. The NICU nurses at CHLA, who already have a history of training other nurses throughout the United States, are now participating in videoconferences with the NICU nurses in Armenia. We also plan to have them remotely proctor specific tasks involved in neonatal resuscitation and oxygen management.

With screening and management of ROP making considerable progress, we are now moving forward in training and proctoring retinal surgeries. The USAID

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has helped fund a surgical suite in a NICU hospital in Armenia, which includes an operating theater specifically for retinal surgery. The first 2 Armenian surgeons spent 1 month in Los Angeles for an initial orientation. They observed pediatric eye surgery, learned the mechanics, and were taught basic concepts. They have now returned to Armenia, where this new surgical suite has all of the most advanced ophthalmic technology, including the E4 Ophthalmic Endoscopy System (Endo Optiks, Inc.) with high-resolution video camera. The video captured with the intraocular endoscope can be streamed live over the Internet so that I can continue to supervise surgery until their training is complete.

THE PATH TO POSSIBLE

There are a number of technological advances that had to happen for telemedicine to be possible, both within ophthalmology and in fiber optic communication. The RetCam is now in its third generation and has recently been joined by video-enabled endoscopy. Both of these components are essential to telemedicine. The expansion of available bandwidth to the consumer has been equally important. The implementation of 4G technology for cellular towers and the widespread availability of SlingBox, a device that encodes video for transmission over the Internet, have been the final step in making live video streaming from Armenia possible.

Moore's Law has held true since 1971, and, if it continues to do so, these applications will only become more practical and accessible. Telemedicine has the potential to accelerate the level of health care for all persons—both in the United States and abroad. This level of distance learning is giving "night school" a whole new meaning. ■

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