# Teleradiology and Teleneurology

## Serving Health Care Needs

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### INTRODUCTION

Health care is known for lagging behind corporate America in its use of computer technology. With the Obama administration proposing to spend $19 billion to encourage the incorporation of electronic medical record systems (EMR) into health care facilities, changes will need to occur (Lohr, 2009). Some improvements have already taken place in an area known as telemedicine. Although telemedicine has been around as long as the telephone, the first video telemedicine was used in the 1920s by neurologists and psychiatrists in Nebraska (Cucina, 2009). At first, any video and audio information was transported physically by the patient to another physician but now this type of information is streamed over secure networks on the web (Cucina, 2009). Telemedicine has been evolving for the last 10 to 12 years and is defined as interactive health care using modern telecommunications (Telemedicine.com, 2007).

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### TELERADIOLOGY

Various practices have become involved in telemedicine and one that has made extensive progress is radiology. Teleradiology is the electronic transmission of radiographic images and related information from one location to another (University of Iowa Hospitals and Clinics, n.d.). The ultimate goal of teleradiology is to become a filmless and paperless solution for the radiology department and patients (General Electric Company, 2009). With the widespread use of digital imaging, it is possible to view images on computers. Teleradiology has been further improved by the development of picture archiving and communication systems (PACS). An average hospital doing "200,000 radiological examinations per year accumulates about 10 gigabytes per day or three to five tetrabytes per year" (Hung, 2002, p. 84) of digital information. PACS are responsible for

managing and storing this huge amount of information for the healthcare facility. Management of the images, as well as the related patient data, is performed by PACS and aids in the streamlining of the patient care process. Improvements in digital imaging in computed radiography (CR), digital radiography, (DR), computed tomography (CT), magnetic resonance imaging (MRI), microscopic imaging (MI), and ultrasound have aided the increased use of teleradiology (Hung, 2002). Also included in teleradiology are x-ray readings in images in nuclear medicine (NightHawk Radiology Services, 2001-2009).

Teleradiology was initially created to aid radiologists in reading and reviewing images from home (Hung, 2002). In a 2003 study, over two thirds of the radiology practices in the United States reported using teleradiology services to send images to the radiologists at home or to outside radiologists. By using a web-based PACS, a radiologist can now read and report on the findings from home, another floor in the hospital, or from the other side of the globe (Steinbrook, 2007).

A radiologist having dinner at a friend's home may be paged to read a CT scan. Before the web-based PACS, he would have gone to the hospital to read the scan and interrupted the dinner. Now, he can use the friend's computer and access the scan on the web. No special program or software is needed. The radiologist uses his specific sign-on to access the website, reviews the scan, and then enters the results into the program. He has done all this without having to leave his dinner (B. M. Hoppenfeld, MD, personal communication, March 26, 2009). The hospital can access the results as soon as the radiologist has completed his report.

Not only have the viewing options increased with the use of the web-based program, but PACS are now able to archive these studies online forever and allow the radiologist to view the file in one to two seconds (General Electric Company, 2006). As long as the computer being used has an Internet connection, the recent and archived files can be viewed. Radiologists require four factors to be present in PACS to be satisfied with the system. The reporting must be accurate for the content, the teleradiology staff must be available to interact with the in-house radiologist and/or physician, there must be technical help available when needed, and there must be an acceptable turnaround time for results (NightHawk Radiology Services 2007).

A referring physician and a radiologist are able to have a telephone consultation while viewing the same images. Many PACS also provide the ability to produce CDs of the image and/or allow e-mailings with encrypted links to the online image to ease the process of sharing images (General Electric Company, 2006). Web-based viewing facilitates the review and discussion of the patient's condition as well as shortens the waiting time for the patient to receive treatment. When the PACS are integrated with the hospital's EMR, and single sign-on is available, the physician has the ability to retrieve information from the patient's medical record as well as viewing other images that are part of the patient study (General Electric Company, 2006).

Emergency departments (ED) are busy 24/7 and often order images from the radiology department as part of their diagnosis for treatment. When the only available radiologist is at home, asleep, there will be a delay until she arrives and reads the image. This impedes the ED physician from treating the patient in a timely manner. This is where international teleradiology steps in to help. When it is 2:30 A.M. in Pennsylvania, it is 9:30 A.M. in Israel and the radiologists there are at work reviewing images. Besides Israel, radiologists working for accredited teleradiology companies are located in Switzerland, India, and Australia (Wachter, 2006). Some images may even be reviewed here in the United States by radiologists in their homes. These

radiologists have set up businesses of their own or may be working evening and weekend hours reviewing images from an affiliated health care provider (Steinbrook, 2007). While the ED radiologist is at one hospital, she can also be reading images for other hospitals in the area as well. Web-based PACS do not put limits on the distance between the radiologist and the facility.

Many teleradiology companies have been accredited by the Joint Commission. This commission is the "standards-setting and accrediting body in health care" (The Joint Commission, 2009, para. 2) and evaluates more than 16,000 health care organizations in the United States. One of these accredited teleradiology companies is NightHawk Radiologist Services, the largest teleradiology company in the United States, headquartered in Coeur d'Alene, Idaho. NightHawk is also in compliance with the American College of Radiology and follows the patient privacy standards put forth by The Health Insurance Portability and Accountability Act (HIPAA) of 1996. NightHawk provides services for a quarter of the hospitals in the United States (Steinbrook, 2007) and has a turnaround time of 20 minutes from the time the images and patient information reaches the teleradiologist until the preliminary evaluation is sent to the hospital. If there is an immediate concern, the local physician is called by the teleradiologist and a plan of care is discussed. If there is no sign of immediate care, the next morning the on-staff radiologist enters a final report and compares his findings with the NightHawk information to ensure comprehensive patient care. The radiologists working for this service are located mainly in the United States, Australia, and Switzerland. All are United States board-certified, state-licensed, and hospital privileged (NightHawk Radiology Services, 2001-2009). This means that the radiologist from NightHawk who is reading the MRI from the ED has the same credentials as the radiologists who are on-staff at the hospital. Many of these radiologists were educated in the United States but are now living elsewhere (B. M. Hoppenfeld, MD, personal communication, March 26, 2009). The teleradiologists may have a room in their house or a facility nearby to use when responding to EDs around the world.

Teleradiology has costs saving benefits right from the start. There is no longer any need for film and chemicals to develop images and therefore no need to have the people or storage necessary to manage and handle them. There is a faster turnaround time since digital images are available immediately and that means the patient has a shortened waiting time. (Hung, 2002). There is no longer a need for the patient to carry and return x-rays after a visit with an off-site physician. The digital images and patient information can now be burned to a CD or provided online, depending on the resources of the physician (General Electric Company, 2006). There had been a problem with opening CDs on other computers; however, since 1993, Digital Imaging and Communication in Medicine (DICOM) has been the global standard for technology information and is used by hospitals, imaging centers, specialists, and clinics around the world (DIACOM, n.d.). Patients also benefit from teleradiology by allowing specialty radiologists to be available to rural area hospitals without the cost and time of travel. Teleradiology is seen as a way to improve the quality of care for all patients, but especially those in rural hospitals. The flexible hours for teleradiologists may make the practice of radiology more attractive to people who would not have considered it before (Steinbrook, 2007).

## TELENEUROLOGY

Neurology, following radiology, psychiatry, and dermatology, has joined the ranks of modern telemedicine. Neurologists have held telephone consultations for

years, but it was not until 2004 or so that e-mail and videoconferencing became part of these consults. The two primary reasons for using teleneurology is to provide care for patients where there is limited ability to provide a face-to-face meeting and to improve the effectiveness of existing services (Patterson & Woolton, 2006).

As was noted before, the medical profession is known for its slow adoption of technologies. This may be one of the reasons teleneurology had not progressed sooner. The use of e-mail and video conferencing technology, both skills which the physicians may need to improve and are included in teleneurology, may be the reasons for the delay (Patterson & Woolton, 2006). Another reason may be the neurologists' use of the hands-on method of practicing. Although an examination is still possible, the neurologist is just an onlooker. Legal concerns may have been a question at one time but, as in teleradiology, teleneurologists are licensed for the country, state, and hospital where the patient is being seen (Specialist On Call [SOC], n.d.).

In the United States, stroke is the third leading cause of death, with 700,000 deaths per year, and the leading cause of disability, with more than 1.1 million cases per year (Baptist Health Care, 2009). There are two types of stroke, the more common (88 %) being an ischemic stroke. This type of stroke is caused by a clot blocking an artery that carries blood and oxygen to the brain. When this occurs, nerve cells in the brain begin to die in a matter of minutes (SOCH, 2007). There is a three-hour window for administering the only approved treatment, which "increases the likelihood of functional independence" (Virtua Health, 2006, ¶ 4). If a person has sudden confusion, trouble seeing, trouble walking, or dizziness, all warning signs of a stroke, and is taken to the ED, there is a chance that the ED physician may miss the fact that the patient is having a stroke. If there is no neurologist to consult, the patient may not get the needed treatment during that 3-hour window. Teleneurology allows a certified neurologist to be available. Specialists On Call (SOC), the largest and only teleneurology consultant company to be accredited by the Joint Commission, can provide these services to the hospital ED (Baptist Health Care, 2009).

SOC, available since 2005, states that everyone wins with their business model: patients and families, on-staff and local physicians, ED staff, and hospitals (SOC, 2008a). The patient and family are seen by a specialist in a timely manner. The physicians and ED staff have a certified neurologist as a consultant in a plan of care for the patient. The hospital avoids violating the federal Emergency Medical Treatment and Active Labor Act (EMTLA). This law states a hospital cannot turn anyone away who needs medial attention. If the hospital does not have the services needed by the patient, the patient may not be transferred to another hospital until he or she is stabilized. The SOC neurologist will assist in stabilizing the patient so he or she can be transported to a hospital with the necessary services (SOC, 2008b).

SOC has a procedure to follow whenever an ED physician needs to consult with a teleneurologist. The consultation begins with a telephone call from the ED physician to the SOC call center, where the needed patient and hospital information is exchanged. The SOC physician will respond to the request within 15 minutes by calling the ED physician. The patient's situation will be reviewed and the next steps decided. If a videoconference is necessary, the portable TeleMD video conferencing device is brought within three feet of the foot of the patient's bed. The monitor provides a way for the patient and family to view and hear the SOC physician. The equipment also includes a speaker and microphone for the audio portion. The SOC doctor can remotely control the video camera as well as zoom close enough to exam the pupil of the patient's eye (C.

Lang, RN, personal communication, April 2, 2009). The SOC physician, professionally dressed, will appear on the screen to discuss the findings with the patient and family. With the assistance of the nursing staff at the patient's bedside, the SOC physician will examine the patient. The ED physician need not be present for this examination. This allows the house doctor to examine another patient while the videoconference occurs. The SOC physician will finish the exam and answer any questions the patient or family may have. When the videoconference is over, the SOC physician will have a telephone consultation with the ED doctor to pass on the neurologist's recommendation for the plan of care The recommendations are then sent by fax to the treating doctor with documentation of the exam (SOC, n.d.). "All recommendations are standardized and evidence based and conform to the latest American Heart Association Standards" (SOC, n.d., p. 5). Patient consent forms are also part of the examination and must be signed by the patient and then faxed to the SOC doctor before the consultation and/or an examination can be completed.

Telemedicine, including teleradiology and teleneurology, have been aiding patients, physicians, and hospitals with necessary care 24/7, whether in a busy city or a rural community. It is unusual to think the "laggards of technology" would be using words like globalization of care, telecommuting, or outsourcing, common terms in the business environment, but it is happening more and more each day.

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