



Teleradiology : A Review article

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Education, Images, Internet, Teleradiology

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ABSTRACT *Teleradiology has made using the Internet explorer possible to access to images and patient findings, to browse, view and write radiological reports on any computer in any location, with all the appropriate rights. Teleradiology may allow more timely interpretation of radiologic images and give greater access to secondary consultations and to improved continuing education. Users in different locations may simultaneously view images. Appropriately utilized, teleradiology may improve access to radiologic interpretations and thus significantly improve patient care. The realization of this concept of teleradiology includes possession of appropriate hardware and software resource and the use of modern radiologic equipment. Teleradiology today forms the future of radiology.*

Introduction

The transmission of images between centres has been established for a number of years and has proved to be valuable for centres seeking expert opinions on emergency and problem cases. More recently radiological images have been transmitted to main centres from outlying hospitals in areas of low population density where small radiology departments have proven unsustainable. The vastly improved capacity of the internet and the speed of transmission has permitted a much wider use of teleradiology with centres around the world providing day-time reporting for out of hours imaging services in other countries in differing time zones. The potential for image transmission is now virtually limitless resulting in major changes to the way radiological services are provided. This change has advantages but also has potential threats to the quality of care provided to patients and to the radiologist's interaction with their clinical colleagues. It is important however, that the quality of radiological services provided for the patient, are of a high standard.^{1,2}

Diagnosis, consultation and education of students, doctors and paramedical staff, research, administration, management, planning and improvement of public health got in telemedicine i.e. in teleradiology new and powerful tools. Radiology greatly contributed to the development of telemedicine, because all the novelties of telemedicine were first implemented in teleradiology^{3,4}.

Teleradiology is a form of medical information system, which requires the use of telecommunications systems in the form of satellite, internet, mobile phones, computers etc. for the exchange of data, images, video, audio or other radiological information in order to secure radiology services between remote locations^{5,6}. For data transfer teleradiology uses the Global System for Mobile Telecommunications (GSM), General Packet Radio Service (GPRS) and 3G systems, which allow the transmission of multimedia content at high speed.

Web technologies in teleradiology enable with appropriate rights (security and confidentiality) using the internet explorer, access to images and findings, to browse, view and write the radiological reports on any computer in any location.

History

The earliest mention of teleradiology dates back to 1929, when two dental radiographs were transmitted in the USA with the help of telegraph to a distant location. The earliest generation of clinical teleradiology starting from the late 1950s was based on the transmission of analogue TV images with either close circuit or broadcast technology, using either real time or videotaped images^{7,8}. However, the image quality was inadequate compared with the quality of film images⁹. In addition, the working logistics were not optimal, as the images had to be sent one by one and the cost of a dedicated installation was high. Once these limitations were recognized, most of the pioneering projects of clinical teleradiology were terminated. Then, in the early 1980s, attention turned to computer-based approaches to telemedicine, with a shift in interest from real-time television applications to "store-and-forward" methods, in which data are collected in digital form at an initiating site and aggregated and stored for subsequent transmission to a receiving site¹⁰. Teleradiology systems became commercially available in the 1980s from a number of vendors, but in retrospect, they were very limited in terms of quality and scalability.

The technology factors holding back teleradiology all changed dramatically^{11,12} in the past 10–12 years with the introduction of lower-cost communications systems such as the Internet, incredible improvements in price versus performance for computers, and wide adoption of picture archiving and communications systems by radiology practices. In the same time frame, medical imaging underwent a transformation from image recording and viewing on film images to the potential for direct digital capture and computer workstation viewing of images from all modalities.

Benefits of teleradiology

The benefits obtained from the appliance of teleradiology are: modernization of the radiology center; digitalization of radiological apparatus; the possibility of obtaining text information, radiological images, video or moving images, their interpretation and sending back to determined destination via Internet; mutual consultations between remote radiologists and other specialists about received information such as x-ray images, US, CT, MRI, PET scans and other biomedical signals; teleeducation of radiologists and other medical staff as an additional possibility for knowl-

edge improvement in medicine, radiology and other fields of medicine; interactive use of electronic medical records; medical monitoring and alarm connecting patients on home care and emergency center; transfer of radiological research data; improving health care; reduction and limitation of the growth of costs in radiology; maintaining the quality of radiological services etc^{3,6}.

Advantages for patients from teleradiology usage are: the availability of top radiologists for the interpretation of findings; radiological findings are obtained without the travel costs and accommodation in one of health care institutions; absence from work and uncertainty of the patient are minimized because the radiologic findings or other opinions are obtained in a very short notice etc.¹³

Benefits from the use of teleradiology for radiologists are: distant specialists' support, creation and improvement of cooperation between radiologists, individual professional advancement through cooperation with other remote radiologist, cooperation of radiological institutions in the country and abroad, no need for travelling to remote locations and accommodations of radiologists in order for them to read radiological images and write radiological findings; increasing of professional competence because of the greater probability to meet statistically less common diseases.

Benefits of appliance of teleradiology for society are: higher quality, performance and availability of health services; the ability to provide superior health services in distant rural areas (eg. islands, mountains, forests, etc); increased employment of medical staff in remote rural areas; reduction of morbidity and mortality of the population; absence from work is minimized; health centers modernization¹⁴.

Disadvantages of teleradiology

The barriers for successful implementation of teleradiology include: problems with telecommunications, energy infrastructure problems, high price and/or unavailability of the Internet. The minimal teleradiological solutions are often informatically too complicated,

unpractical to use and do not have all the necessary functions etc.

Meeting the Goals Of Teleradiology

Ultimately, the purpose of off-site image interpretation is to provide better and faster delivery of patient care.

SPEED

The ability to quickly move images from place to place lends itself to the provision of fast and responsive imaging interpretation. The implementation of a teleradiology program should be associated with improved delivery of services by those who utilize radiology most frequently.

Some systems allow lower-resolution images to be visualized almost immediately while the case is in the process of downloading. This allows the radiologist to quickly visualize a crucial finding such as a ruptured aortic aneurysm in seconds and begin to take the necessary steps to ensure that prompt care is provided to the patient. Speed can also be enhanced using a system that can be configured to display the most recently completed examinations at the top of a patient list. This allows a radiologist to begin to access a study before a technologist even notifies him or her of the case.¹⁵

MANPOWER

By its very nature, emergency radiology comes in bursts. Maintaining the manpower requirements to provide immediate attention to potentially critical patients during these bursts can be very inefficient for the vast majority of time when the ER pace is not as frenzied. This can be true for small departments where even a single radiologist is not needed for most of the overnight hours and for larger departments where a single radiologist may have difficulty keeping up during the busiest spurts, but 2 radiologists would be unnecessary for the vast majority of the time¹⁵.

RELATIONSHIPS WITH COLLEAGUES

The knowledge that radiologists are working from home or from a beachfront office in Hawaii does not necessarily impart an endearing first impression to nonradiologists that spend long hours each day in hospital wards. To maximize the success of a teleradiology practice, it is imperative to provide these doctors with benefits that they would not have expected from their radiology departments prior to the implementation of teleradiology. Outpatient doctors that begin to receive same-day reports from subspecialists on patients sent to an imaging center and ER physicians that start to get head CT results before their patients return from the scanner are more likely to write complimentary letters to a radiology chairman than to be bothered by where a radiologist may be sitting while the images are being interpreted.

Teleradiology should not result in weaker relationships between radiologists and colleagues in other fields. If referring physicians do not see a teleradiologist's face, effort should be made to ensure that they recognize their teleradiologist's voice and personality.

PATIENT CARE

The benefits of teleradiology that result in better service will by their nature impact patient care. Ultimately, it is the patients who benefit most by having their imaging interpreted by a subspecialist. Night call has often been considered by many to be the least desirable part of a radiologist's practice. Many departments demand that all full-time members share this responsibility equally¹⁵. This can mean that subspecialized radiologists who do not routinely interpret important emergency imaging modalities such as CT in the daytime are forced to provide coverage for these modalities at night. With no backup readily available, vital decisions on ER and trauma patients must be made by these radiologists all night long.

CONCLUSION

Teleradiology is a set of procedures for transferring radiological information in electronic form. Teleradiology enables interactive connection between professionals and patients, as well as long-distant consultations. Information transmitted by teleradiology include information on medicine, radiology, static images, moving images, complete medical records, etc. Teleradiology has grown into a global service with almost unlimited possibilities. The realization of this concept of teleradiology includes possession of appropriate hardware and software resource and the use of modern radiological equipment. Teleradiology today forms the future of radiology.

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