

Tele Radiology

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Abstract

The conversion from analog to digital methods in the medical imaging world and the emergence of widely available mechanisms to quickly and affordably transmit digital data over large distances has fueled the rapid growth of tele radiology. In modern radiology departments in both the academic and private sectors it has become commonplace to select the location of a fully functioning picture and archiving communications system (PACS to the site of image acquisition. In addition, affordable scaled down tele radiology solutions have allowed referring physicians and radiologists to access imaging from the convenience of their homes and offices.

Keywords: *Tele Radiology, National Aeronautics and Space Administration (NASA)*

INTRODUCTION

Tele-radiology is the electronic transmission of radiologic images from one location to another for the purposes of treating patients in emergencies. Tele radiology may allow more timely clarification of radiologic images and give better access to subordinate consultations and to improved continuing education. Users in different locations may

instantaneously view images. Tele-radiology is not appropriate if the available tele radiology system does not provide images of sufficient quality to perform the indicated task. When a tele radiology system is used to render the official interpretation, there should not be any significant loss of data from image acquisition through transmission. For transmission of images for display use

only, the image quality should be sufficient to satisfy the needs of the clinical circumstance.

This standard defines goals, qualifications of personnel, equipment guidelines, licensing, liability, communication, and quality improvement for tele radiology. While not all-inclusive, the standard should serve as a model for all physicians and healthcare workers who utilize tele radiology. A vocabulary of usually used language and a reference list are involved.

2. HISTORY AND EVOLUTION

The use of on-call tele radiology for interpretation of images from off-hours examinations has continued to increase, due to the part of the activities of a number of commercial enterprises founded specifically to provide outsourced coverage for radiology practices but also due to some academic and isolated rehearses that have begun offering considerably similar facilities.

Within the Partners HealthCare System in Boston, Mass, both the Massachusetts General Hospital and the Brigham and Women's Hospital, sections of radiology suggests nighttime tele-radiology attention amenities. Both departments have their own interior 24-hour-per-day

reporting squads and take benefit of that facility to help smaller facilities in the region by providing tele radiology coverage.

Hundreds of hospitals and radiology groups have taken advantage of the services of outsourcing companies or other radiology groups to provide and maintain timely radiology cover-age for their institutions and to make better use of their own labor while upholding a realistic work life. Advertisements for radiologists to join groups now often include specific reference to whether the group has such nighttime coverage.

The National Aeronautics and Space Administration (NASA) has been an innovator in the use of telemetry of medical information to track the well-being of cosmonauts in space and has a long history of attention in telemedicine. NASA applied lessons learned in space (5) to a demonstration project entitled "Space Technology Applied to Rural Pap ago Advanced Health Care," or STARPAHC, that served the Pap ago Indian Reservation in Arizona during a period in the 1970s. The project received mixed re-views for cost and practicality.

NASA has remained steadfast in its interest in telemedicine and has continued to help advance the field. NASA successfully started a recent demo project in the use of ultrasonography (US) on the International Space Station. Astronauts with minimal training in imaging examined each other's shoulders, Sinologists at NASA's Tele science Center in Houston, Texas, directed that with images transmit-ted back to Earth for review.

The rapidity and importance of the technologic progress supporting tele radiology is well verified in some of our first determinations at Massachusetts General Hospital (MGH). When we first established a tele radiology link between Riyadh, Saudi Arabia, and MGH in 1994, it took over 1 week of effort by two engineers sent from the United States to assemble the special proprietary equipment that had to be shipped in by airfreight.

Establishing the communications link required working with the local telephone provider. The communications link consisted of four multiplexed voice-grade phone lines yielding a transmission rate of less than 40 kilo-bits/sec. At this rate, it took 2–5 minutes to transmit

conventional radiographs digitized at a matrix resolution of 1664 2020 with 12-bit pixels and com-pressed at an average ratio of 23:1. The equipment and software were all- proprietary and cost over \$100 000.

Only 3 years later when we established a tele radiology service between a hospital in Istanbul, Turkey, and MGH, the hospital in Istanbul simply purchased a personal computer and film digitizer on the local market, and a transmission pathway was established over the Inter-net in about 2 hours of telephone conversation and testing by engineers working together at each site.

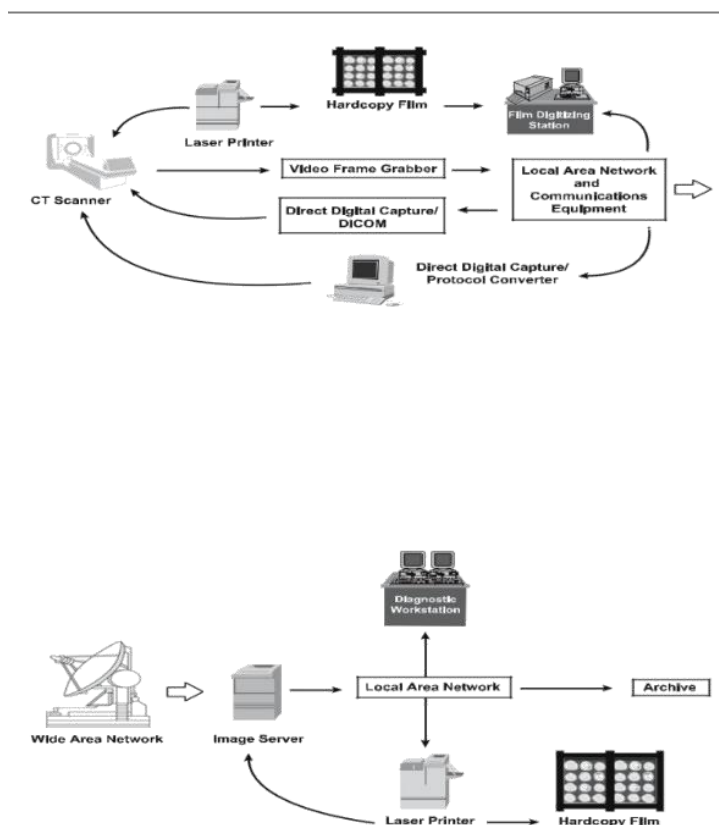
Today, the mixture of shortest digital capture ability in radiology, the widespread recognition of picture archiving and communications systems, the availability of low cost personal computer– based workstations, and advances in data compression and transmission methods make it almost trivially easy to establish tele radiology links between sites.

3. GOALS

Tele radiology is an evolving technology. New goals will continue to emerge. The current goals of tele radiology includes

- a. Providing consultative and interpretative radiologic services.
- b. Making radiologic consultations available in medical facilities without on-site radiologic support.
- c. Providing timely availability of radiologic images and image interpretation in emergent and non-emergent clinical care areas.
- d. Facilitating radiologic interpretations in on-call situations.
- e. Providing subspecialty radiologic support as needed.
- f. Enhancing educational opportunities for practicing radiologists.
- g. Promoting efficiency and quality improvement.

4. IMAGE ACQUISITION



5. IMAGE TRANSMISSION

Trained personnel qualified in the examination to be done must perform the radiologic examination at the transmitting site. In all cases, this means a licensed and/or registered radiologic technologist, radiation therapist, nuclear medicine technologist, or sonographer. This technologist must be under the supervision of a qualified licensed physician. It is desirable to have a Capable Medical Physicist and/or image administration specialist on spot or as advisors.

5.1. Physician

The official interpretation of images must be done by a physician who has

- 1) An understanding of the basic technology of tele radiology, its strengths and weaknesses (as well as limitations), and who is knowledgeable in the use of the tele radiology equipment.
- 2) Demonstrated qualifications as delineated in the appropriate American College of Radiology (ACR) guidelines or standards for the particular diagnostic modality being transmitted through tele radiology.

5.2. Image Management Specialist

- 1) The image management specialist is an individual who is qualified to assess and provide problem-solving input, initiate repair, and coordinate system-wide conservation agendas to assure supportable high-image quality and system function. This individual would also be directly involved with any system expansion programs.
- 2) This professional should be accessible in an appropriate manner in case of malfunction, and return it to optimal system functionality.

5.3. Acquisition Or Digitization

Initial image acquisition should be done in accordance with the appropriate ACR modality or examination guideline or standard.

1. Direct Image Capture

The entire image data set produced by the digital modality in terms of both image matrix size and pixel bit depth, should be moved to the tele radiology system. It is recommended that the DICOM standard be used.

2. Secondary Image Capture

a. Small matrix images: Each different image should be digitized to a matrix size as large as or larger than the original image by the imaging modality. The images should be digitized to a minimum of 8 bits pixel depth. Film digitization or video frame grab systems conforming to the above specifications are acceptable.

b. Large matrix images: These images should be digitized to a matrix size of 2.5 lp/mm or greater, restrained in the original indicator plane. These images should be digitized to a minimum of 10 bits pixel depth.

5.4. Compression

Data compression may be used to increase transmission speed and reduce storage requirements. Several methods may be used, under the direction of a qualified physician, with no reduction in clinically significant diagnostic image quality. The types and ratios of compression used for different imaging studies transmitted and stored by the system should be selected and periodically reviewed by the responsible physician to ensure appropriate clinical image quality.

5.5. Transmission

The environment of the studies to be transmitted will dictate the type and specifications of the transmission devices used. In all cases, for official interpretation, the digital data received at the receiving end of any transmission must have no loss of clinically significant information. The transmission system shall have adequate error-checking capability.

5.6. Display Capabilities

Display workstations used for official interpretation and employed for small-matrix and large-matrix systems should provide the following characteristics

- 1) Luminance of the gray-scale monitors should be at least 50 foot-lamberts.
- 2) Lighting in the reading room that can be controlled to eliminate reflections in the monitor and to lower the ambient lighting level as much as is feasible.
- 3) Capability for selecting image sequence.

5.7. Archiving And Retrieval

If electronic archiving is to be employed, the guidelines listed below should be followed

1. Tele radiology systems should afford for storage capability adequate to obey with all ability, state, and central regulations regarding medical data preservation. Images stored at either site should meet the jurisdictional requirements of the transmitting site. Images interpreted to the receiver need not be stored, provided they are kept at the communicating site. However, if the images are retained at the reception site, the retention period of that jurisdiction must be met as well. The policy on record retention must be in writing.

2. Each test data file must have an accurate corresponding patient and test database record that includes patient name, identification number, examination date, type of examination, and facility at which examination was performed.

3. Prior examinations should be retrievable from archives in a period appropriate to the clinical needs of the facility and medical staff.

5.8. Security

Tele radiology systems should provide network and software security protocols to protect the confidentiality of patients' identification and imaging data consistent with federal and state legal requirements. There should be measures to safeguard the data and to ensure data integrity against intentional or unintentional corruption of the data.

5.9. Reliability And Redundancy

The patient care is dependent on the timely availability of the image data. Written policies and procedures should be in place to ensure continuity of tele radiology services at a level consistent with those for hard-copy imaging studies and medical records within a facility or institution. This should include interior severance systems, backup telecommunication links, and a catastrophe plan.

6. ON-CALL TELERADIOLOGY

The use of on-call tele radiology for interpretation of images from off-hours examinations has continued to increase, due in part to the activities of a number of commercial enterprises founded exactly to provide subcontracted off-hours attention for radiology observations, but also due to some educational and private practices that have begun offering

substantially similar services.. Within the Partners HealthCare System in Boston, Mass, both the Massachusetts General Hospital and the Brigham and Women's Hospital departments of radiology offer nighttime tele radiology coverage services. Both departments have their own internal 24-hour- per-day coverage teams and take advantage of that service to help smaller facilities in the region by providing tele radiology coverage.

Hundreds of hospitals and radiology groups have taken advantage of the services of outsourcing companies or other radiology groups to provide and maintain timely radiology cover-age for their institutions and to make better use of their own labor while maintaining a reasonable work life. Advertisements for radiologists to join groups now often include specific reference to whether the group has such nighttime coverage.

7. BENEFITS

Tele radiology allows the broadcast of imageries from an imaging base to an analytical center. There are key advantages of this process

1. For those communities which lie at a considerable distance from a major center and where there is insufficient work to

justify the appointment of local radiologists, tele radiology allows the images to be taken in the patient's neighborhood and moved for understanding to a main point. This has certain cost in less populated areas, such as Scotland and Wales in the United Kingdom, northern parts of Sweden, Norway and Finland, some of the low-populated areas of France, Spain and some of the some islands of Greece.

2. Images of complex problems can be transmitted from hospitals where expertise is focused on general radiological services to major tertiary centers for evaluation and advice. This also has the advantage that the tertiary centers can decide whether a patient needs transfer from the smaller hospital to the tertiary Centre for treatment without unnecessary discomfort and disruption for the patient. Broad radiologists can also get secondary opinions from subspecialists with simplicity and a degree of rapidity, which allows them to manage patients in their own neighborhoods.

3. The use of other centers to provide emergency reports on images where the local Centre does not have sufficient radiologists to provide a 24-hour cover have recently been developed.

In particular, where there is a time difference between geographical zones, tele radiology may become an efficient method of giving a rapid report for emergency work undertaken out of hours where no radiologist is immediately available.

CONCLUSION

Tele radiology is already being used around the world and will become commonplace, as information transfer networks increase in capacity and extent. Tele radiology should not be developed simply to provide a low-cost reporting service through cross-border service provision. Radiological reports are more analogous to clinical consultations than simply numerical biochemical results. Tele radiology services should be managed by referring radiologists in order to preserve multi- disciplinary care for the benefit of patients and to support radiologists to improve the quality of diagnosis in complex or specialist problems. There must be clearly defined and agreed processes of image transfer, prioritization of reporting, reporting styles, interaction with host departments, host hospitals and primary-care doctors and agreement protocols. The legal framework and patient safeguards under which tele radiology services develop must be robust.

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