

TELERADIOLOGY GUIDELINES

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PREAMBLE

It is clear that with advent of globalisation and new technology, there is now an ability to provide radiology reading services from a distant location. With increasing demands for services and the necessity for lowering the cost for some of these, many institutions are now evaluating options that are available including teleradiology.

The College of Radiologists, Singapore believes that clinical radiology services are still best provided by institutions with properly staffed and equipped departments within Singapore itself.

Notwithstanding this, it is appropriate that some guidelines should be put in place to ensure that the practise of teleradiology can be exploited when necessary but at the same time determine a degree of safety to ensure standards are put in place for the protection of the patient.

These guidelines are not meant to be rules or regulations but to assist in establishing a standard of care in the practice of this still evolving field.

I. INTRODUCTION

Teleradiology is the electronic transmission of all radiological images from one geographical location to another for purposes of interpretation and /or consultation. There is no doubt that appropriately utilised, this process may improve access to radiological services in areas which are underprovided for. The use of this technology has also been boosted by advances in the production, storage and transmission of digital images resulting in large data sets and high-resolution examinations being transmitted without significant loss of data.

Although there have been studies in various countries attempting to fully evaluate the potential of teleradiology, there is uncertainty with a need for further study to assess both the full potential of benefits and difficulties of trying to integrate this technology into the working environment of hospitals, clinical practice and the imaging department.

It is without doubt that this technology must be safely utilised and an effective teleradiology service must reflect local clinical needs, involve institutional local radiologists and also command the confidence of the local clinical practitioners.

The guidelines will attempt to suggest qualification of personnel, equipment guidelines, credentialing liability, communication, quality control and improvement.

It is also realised that these guidelines will not be all inclusive nor will it be an inflexible rule of requirement of practice. Hopefully these guidelines will help potential users and providers to achieving the objective of a better level of patient care through teleradiology.

II. EQUIPMENT SPECIFICATIONS (Adopted from ACR)

Specifications for equipment used in teleradiology will vary depending on the individual facility's needs, but in all cases it should provide image quality and availability appropriate to the clinical need.

Compliance with the ACR/NEMA (National Electrical Manufacturers Association) Digital Imaging and Communication in Medicine (DICOM) standard is strongly recommended for all new equipment acquisitions, and consideration of periodic upgrades incorporating the expanding features of that standard should be part of the continuing quality improvement program.

Equipment guidelines cover two basic categories of teleradiology when used for rendering the official interpretation: small matrix size (e.g., computed tomography {CT}, magnetic resonance imaging {MRI}, ultrasound, nuclear medicine, digital fluorography, and digital angiography) and large matrix size (e.g., digital radiography and digitised radiographic films).

Small matrix: The data set should provide a minimum of 512 x 512 matrix size at a minimum 8-bit pixel depth for processing or manipulation with no loss of matrix size or bit depth at display.

Large matrix: The data set should allow a minimum of 2.5 lp/mm spatial resolution at a minimum 10-bit pixel depth.

A. Acquisition or Digitisation

Initial image acquisition should be performed 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 transferred to the teleradiology system. It is recommended that the DICOM standard be used.

2. Secondary image capture

a. Small matrix images: Each individual image should be digitised to a matrix size as large as or larger than that of the original image by the imaging modality. The images should be digitised to a minimum of 8 bits pixel depth. Film digitisation or video frame grab systems

conforming to the above specifications are acceptable.

- b. Large matrix images: These images should be digitised to a matrix size corresponding to 2.5 lp/mm or greater, measured in the original detector plane. These images should be digitised to a minimum of 10 bits pixel depth.

3. General requirements

At the time of acquisition (small or large matrix), the system must include annotation capabilities including patient name, identification number, date and time of examination, name of facility or institution of acquisition, type of examination, patient or anatomic part orientation (e.g., right, left, superior, inferior) and amount and method of data compression.

The capability to record a brief patient history is desirable.

B. Compression

Data compression may be used to increase transmission speed and reduce storage requirements. Several methods, including both reversible and irreversible techniques, 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.

C. Transmission

The type and specifications of the transmission devices used will be dictated by the environment of the studies to be transmitted. 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.

D. 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.
4. Capability of accurately associating the patient and study demographic characteristics with the study images.
5. Capability of window width and level adjustment, if those data are available.
6. Capability of pan and zoom functions.
7. Capability of rotating or flipping the images provided correct labelling of patient orientation is preserved.
8. Capability of calculating and displaying accurate linear measurements and pixel value determinations in appropriate values for the modality (e.g.

- Hounsfield units for CT images), if those data are available.
9. Capability of displaying prior image compression ratio, processing, or cropping.
 10. The following elements of display:
 - a. Matrix size.
 - b. Bit depth.
 - c. Total number of images acquired in the study.
 - d. Clinically relevant technical parameters.
- When the display systems are not used for the official interpretation, they need not meet all the characteristics listed above.

E. Archiving and Retrieval

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

1. Teleradiology systems should provide storage capacity sufficient to comply with all facility, state, and federal regulations regarding medical record retention. Images stored at either site should meet the jurisdictional requirements of the transmitting site. Images interpreted off-site need not be stored at the receiving facility, provided they are stored at the transmitting site. However, if the images are retained at the receiving site, the retention period of that jurisdiction must be met as well. The policy on record retention must be in writing.
2. Each examination data file must have an accurate corresponding patient and examination database

- record that includes patient name, identification number, examination date, type of examination, and facility at which examination was performed. It is desirable that space be available for a brief clinical history.
3. Prior examinations should be retrievable from archives in a time frame appropriate to the clinical needs of the facility and medical staff.
 4. Each facility should have policies and procedures for archiving and storage of digital image data equivalent to the policies for protection of hard-copy storage media to preserve imaging records.

F. Security

Teleradiology 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.

G. Reliability and Redundancy

Quality patient care may depend on timely availability of the image interpretation. Written policies and procedures should be in place to ensure continuity of teleradiology services at a level consistent with those for hard-copy imaging studies and medical records within a facility or institution. This should include internal redundancy systems, backup telecommunication links, and a disaster plan.

III. LICENSING, CREDENTIALING AND LIABILITY

A. Qualifications of Medical Practitioner

The Medical Practitioner/physician providing teleradiology services must hold a current SMC/SAB registration or qualifications acceptable to SMC/SAB for registration at both the transmitting and receiving sites.

The medical practitioner when providing interpretation of images from hospitals should be credentialed and obtain appropriate privileges at that particular institution.

These doctors should have professional liability cover to ensure coverage in both the transmitting and receiving sites. The doctors performing the interpretation should be responsible for the quality of the images reviewed.

Transmitted images need to be stored at either the receiving facility or the transmitting facility. If they are stored at the receiving facility, the period of storage should be in accordance with at least that of the site of transmission. There should be written documentation stating clearly the policy of record retention and agreed to by both sides.

The conduct of the physician/medical practitioner involved in teleradiology should be in a manner consistent with the laws and regulations for patient care at the transmitting site.

B. Qualifications of Administrative Staff

It is desirable to have either an imaging management specialist or a qualified medical physicist on site or as consultants. The management specialist should be qualified to assist and provide

problem-solving input, initiate repair and coordinate system wide maintenance programmes to assure sustainable high image quality and system function.

This individual should also be available in a timely manner to ensure return to optimal function should there be cases of malfunction.

C. Manager/Clinical Director

There should be a clinical director/manager who should be registered with the transmitting site as the ultimate person responsible for the provision of the service, the accuracy and timeliness of the reporting and all other relevant quality control issues.

D. Training in Teleradiology

All personnel providing any aspect of the teleradiology process must have undertaken appropriate training in the policies and procedures established for teleradiology. This should be documented.

The training should include all clinical and technically relevant aspects of teleradiology with documentation of the identity and qualifications of the trainer and the level of competence achieved.

E. Teleradiology Procedures Manual

The teleradiology practice must have in place documented policies and procedures for the use of teleradiology. This document must, as a minimum complies with relevant legislative/legal/professional requirement for a medical imaging facility.

F. **Delegation of Tasks/Functions**

The delegation of tasks from members of the team must be performed under a documented framework developed and implemented by the practice.

G. **Others**

There have been issues raised with regards to ensuring that the provision of reading services should be done by scheduled and appropriately qualified and credentialled medical personnel. Various security measures can be implemented to ensure monitoring for this including thumbprint recognition technology and constant videocam recording.

Policies relating to these need to come from the referring institutions.

IV. **QUALITY CONTROL AND IMPROVEMENT PROGRAMME (Adopted from ACR)**

1. Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

Any facility using a teleradiology system must have documented policies and procedures for monitoring and evaluating the effective management, safety, and proper performance of acquisition, digitisation, compression, transmission, archiving, and retrieval functions of the system. The quality control program should be

designed to maximise the quality and accessibility of diagnostic information.

A test image, such as the SMPTE test pattern, should be capture, transmitted, archived, retrieved, and displayed at appropriate intervals, but at least monthly, to test the overall operation of the system under conditions that simulate the normal operation of the system. As a spatial resolution test, at least 512 x 512 resolution should be confirmed for small-matrix official interpretation, and 2.5 lp/mm resolutions for large-matrix official interpretation.

As a test of the display, SMPTE pattern data files sized to occupy the full area used to display images on the monitor should be displayed. The overall SMPTE image appearance should be inspected to assure the absence of gross artefacts (e.g. blurring or bleeding of bright display areas into dark areas or aliasing of spatial resolution patterns). Display monitors used for primary interpretation should be tested at least monthly. As a dynamic range test, both the 5% and the 95% areas should be seen as distinct from the respective adjacent 0% and 100% areas.

The use of teleradiology does not reduce the responsibilities for the management and supervision of radiologic medicine.

2. There has to be in place a quality control audit system to ensure that discrepancy reporting is evaluated. In institutions, formal and informal feedback occurs at clinical radiological meetings and through discussion with clinicians in the reporting room, consultation offices. These essential activities are much more difficult within a teleradiology service.

As such the audit system should form an essential component of radiology quality assurance within a teleradiology provider. There should be in place both an internal quality control audit by the

teleradiology providing service and also an external audit to be done by the transmitting facility.

Quality issues should include error rates, impact on service within the institution, transcription errors and so forth.

These should be documented in an orderly and timely fashion and be available for external audit when and if required.

There should be a clearly defined agreement with any teleradiology service with regards to confidentiality issues.

3. Others

A pre-qualification inspection and exercise in assessing the teleradiology providers should be considered.

A testing phase should be organised for every new provider or service that is to be provided. Formal reading services should only start after final approval of the test reads

This should be followed by an evaluation period during which all reports are subject to double-checking.

V. ACKNOWLEDGEMENTS

The panel reviewed recommendations from the American College of Radiology, The Royal College of Radiologists UK and the Royal Australian and New Zealand College of Radiologists.

These were noted to be fairly comprehensive and the panel felt that there was no advantage in attempting to start the process again. The panel therefore has adopted large components of the recommendations from these bodies and we acknowledge their contribution to our recommendations.

1. ACR Technical Standard For Teleradiology

2. Teleradiology – A Guidance Document for Clinical Radiologists – Royal College of Radiologists (2004)

3. Standards of Practice for Diagnostic Imaging – The Royal Australian and New Zealand College of Radiologists