

# **GUIDELINES FOR TELERADIOLOGY PRACTICE IN MALAYSIA**

**Prepared by the College of Radiology Malaysia Teleradiology Taskforce . ( CORMTT)**

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## **1. TELERADIOLOGY - BACKGROUND AND GENERAL INFORMATION.**

Teleradiology is the transmission of diagnostic radiological images, such as x-rays, CTs, and MRIs, from one location to another for the purposes of primary review and interpretation as well as specialist consultation. It is a promising technology as the growth in imaging procedures supersedes growth in radiologist population.

Teleradiology utilizes standard network technologies such as the internet, telephone lines, wide area network, local area network (LAN) and the latest being Cloud Technology. Specialized software is used to transmit the images and enable the radiologist to effectively analyze what can be hundreds of images for a given study. Technologies such as advanced graphics processing, voice recognition, and image compression are often used in teleradiology. Through tele radiology and DICOM viewers, images can be sent to another part of the hospital, or to other locations around the world with ease.

For both public and private health care providers, teleradiology is a vehicle for maintaining quality while containing cost.

The benefits accrued to teleradiology include more timely interpretation of radiological images, greater access to secondary consultations, in addition to providing improved continuing medical education, the ultimate objective of which is to significantly improve patient care.

Teleradiology improves patient care by allowing radiologists to provide services without actually having to be at the location of the patient. This is particularly important when a sub-specialist such as a MRI radiologist, neuroradiologist, pediatric radiologist, or musculoskeletal radiologist is needed, since these professionals are generally only located in large cities and work only during daytime hours. Teleradiology allows for trained specialists to be available in case of emergency cases reporting after normal working hours from by their resident radiologist from home without need for the radiologist to come into the hospital.

It is essential that any teleradiology system provides images of sufficient quality without any loss of spatial or contrast resolution. Compressed images often lose integrity and are not readable and usable.

In short, a good teleradiology system uses no compression, is DICOM standard compliant, Image storage facilities are secured and well-protected, the portal is web-based for easy viewing and reporting and the images may be sent directly to the cloud either direct from the modality or through the in-house PACS system. Sending images using email, whatsapp, Google drive or

other transfer methods should not be allowed for purposes of reporting a set of images as the quality of the imaging is not adequate for primary reporting.

A good teleradiology system is also cost efficient, fast turnaround time, 100% reliable, image sharing is simplified and the storage is expandable.

The American College of Radiology Teleradiology Task Force has recommended four central principles for all teleradiology activities which has been adopted by the College of Radiology Malaysian Teleradiology Taskforce. (CORMTT).

1. All teleradiology relationships should be patient centered and “secondary incentives, financial or otherwise, should never supersede patient primacy.”
2. On-site coverage is preferred, and teleradiology services should ideally be supplemental to a comprehensive on-site radiology practice.
3. Teleradiologists and on-site radiologists should both follow the same professional standard of quality.
4. Teleradiology service should not be outside of local safety and quality operations, and it should be assimilated into the usual medical staff credentialing and privileging process.

## **II. DEFINITION**

Teleradiology is the electronic transmission of diagnostic imaging studies from one location to another for the purposes of interpretation and/or consultation.

This definition includes interfacility PACS networks as well as remote teleradiology.

This document is prepared to draw up guidelines with regards to the practice of Teleradiology in Malaysia.

## **III. . CIRCUMSTANCES IN WHICH TELERADIOLOGY MAY BE UTILISED:**

Currently the CORMTT recommends Teleradiology be utilized in the following circumstances:

1. Reporting using Teleradiology by the resident full time radiologists of an institution to report cases performed at their own institution . This is particularly for reporting of cases after hours or when on leave and their service may be required.
2. Reporting using Teleradiology by visiting radiologists to an institution that does not need a full time resident radiologist. These visiting radiologists provide some primary on site services as locums and have APC for the centre but are required to report cases done when the radiologists are not request assistance .
3. Reporting using Teleradiology by third party radiologists who are not resident or visiting on site radiologists only when both of the above are not available or the above cannot cope with the existing workload. The resident radiologists and visiting radiologists must agree to third party teleradiology services.
4. Reporting using Teleradiology by Malaysian radiologists of Imaging done in countries abroad as

- a means of generating foreign income for the Malaysian economy.
5. Subspecialist reporting services eg neuroradiology , musculoskeletal radiology etc.

In all of the above Teleradiology services , medical officers at the institution must be trained and available to inject contrast and handle any imaging or medical emergencies in the Radiology department if the resident or locum radiologists are not in the department .

#### **IV. QUALIFICATIONS, CREDENTIALLING, LICENSING, RESPONSIBILITIES & GUIDELINES OF SERVICE OF PERSONNEL**

The general principals which the CORMTT recommends to be adopted are as follows:

Radiologists who practice teleradiology must possess and maintain appropriate professional qualifications. These are:

- Are fully registered with Malaysian Medical Council
- Have a valid and current Annual Practicing Certificate
- Are registered with National Specialist Register
- Have sufficient medical indemnity coverage

Radiologists residing in Malaysia and reporting images from outside Malaysia must conform to the regulations of the country where the images are from. He must ensure that his indemnity coverage applies to the countries where the images are coming from.

Radiologists residing outside Malaysia and are reporting images from Malaysia must conform to the regulations of Malaysia. He must ensure that his indemnity coverage applies to Malaysia. Before being able to report, the radiologists must be credentialed and privileged by the individual hospital or radiology centre where the images originate. However, CORMTT recommends that reporting of Teleradiology by Radiologists from outside the country should not be allowed as Malaysia has sufficient skilled radiologists and subspecialists to provide Teleradiology reporting. This will also protect the Malaysian radiologists from having unfair and unhealthy competition with regards to reporting fees which can be sourced cheaper from overseas countries especially third world countries.

#### **Continued Quality Improvement**

Teleradiologists, like all radiologists, should participate in quality improvement initiatives. This includes meeting the requirements for continuing medical education (CME) and any other mandated quality initiatives.

More detailed description of the Radiologists requirements and other related matters to the Radiologist are listed below:

#### **A. Radiologists**

A Radiologist is a specialist physician, who uses imaging based modalities and techniques in the practice of medicine for diagnosis and treatment. Teleradiology is one of these imaging based techniques.

Radiologists involved in the performance, supervision and interpretation of teleradiology from institutions within Malaysia must have one of the following specialist degrees.

List of degrees or qualifications accepted by MMC to be considered a Radiologist in Malaysia:

- a. Master of Medicine Radiology, Universiti Kebangsaan Malaysia [MMed. Rad (UKM)]
- b. Master of Radiology, University of Malaya [MRad (Mal)]
- c. Master of Medicine Radiology, Universiti Sains Malaysia [Mmed.Rad (USM)]
- d. Doctor of Radiology, Universiti Kebangsaan Malaysia [DrRad (UKM)]
- e. Fellow of the Royal College of Radiologists United Kingdom [FRCR (UK)]
- f. Fellow of the Royal College of Australia and New Zealand College of Radiologists (FRANZCR)
- g. Fellow of The Faculty of Radiologists of The Royal College of Surgeons of Ireland (FFRCSI)
- h. Master of Medicine, Radiology, International Islamic University Malaysia (MMed.Rad (UIAM))– no graduates yet
- i. Master of Medicine, Radiology, Universiti Putra Malaysia (MMed.Rad (UPM)).

For the current moment, there is ample supply of Malaysian and permanent residents of Malaysia radiologists with the above qualifications. They comprise both general radiologists and subspecialists radiologists. As such, the College of Radiology feels foreign Teleradiology services or non-citizen radiologists should not be allowed to provide Teleradiology reporting to Malaysian institutions.

However, exceptions for a few cases to be sent to tertiary centre expert Radiologists abroad eg USA or Europe for second opinion by Teleradiology will be allowed. This however is not on a regular basis or contract.

In the case where third world or underdeveloped countries with limited resources require Teleradiology services from Malaysian radiologists particularly subspecialists, this should be allowed as long as the medico-legal implications are addressed . One way of addressing this is

that the country which is requesting the service registers the Malaysian radiologist for practice in their country and also enables them to purchase medical defense coverage from that country.

At the time of writing of this document subspecialty recognition is given by the Ministry of Health, Malaysia for those working in the Ministry of Health and by the University for a lecturer working in a University based job . Normally an official letter or certificate should have been provided to attest the above subspecialisation. The National Specialist Register at this moment in time has decided not to register subspecialist training and only register Clinical Radiology as a specialty.

The radiologist must be appropriately credentialed and privileged by the institution in which the examination is performed. The radiologists who are involved in practicing teleradiology will conduct their practice in a manner consistent with the bylaws, rules, and regulations for patient care at the site in which the patient undergoes the examination. Teleradiologists should be credentialed for reporting of certain procedures ascertained by their current practice. If they are regularly reporting many cases eg mammography in their institution and their reports are accepted by the specialists of their own institution they will be allowed to report similar Teleradiology cases for other institutions. Following the above guideline will protect the patients interests and no argument will be entertained that basic training included all modalities and therefore a radiologist is allowed to report all cases even if they do not do so presently at their institution on a regular or occasional basis. Common sense should prevail in determining this matter. The College of Radiology should consider forming an arbitration committee in case of disputes regarding Teleradiology and even Radiology practice by its members and specialty so that the reputation of the Specialty is not tarnished by a few Radiologists. Continuing professional development should be maintained each year to improve radiology interpretation skills as much as possible and follow any new regulations imposed by the Malaysian Medical Council.

The official interpretation of images must be done by a radiologist with an understanding of the basic technology of Teleradiology including its strengths and limitations. This includes appropriateness screening, supervision of technical standards and procedures, image interpretation and consultation. This safeguard allows teleradiology to be equivalent to on-site radiology in selected instances.

Provision must be made by the reporting radiologist to provide a consultative service. The reporting radiologist has a pivotal role in all aspects of the diagnostic imaging examination. The reporting radiologist must be available by phone to the referring physician to discuss any report if required and this is the reason why the resident or locum radiologists of an institution should be given first right to report Teleradiology cases from their own institution at work or from their homes.

The radiologist workload for teleradiology and on site should be at a level that quality of care and interpretation accuracy are not compromised.

The teleradiology reporting radiologist should be involved in decisions involving teleradiology specifications and image quality at the time of purchase if possible. The teleradiology radiologist should be firstly chosen from the visiting radiologists providing onsite service to the institution on a regular basis. This will allow the physicians to consult the radiologist directly using the PACS to address some of the queries they may have on a particular case and the radiologist can point out the abnormalities or look for any particular query side by side with the physician during their regular on-site visit.

Payment to the radiologists for Teleradiology shall follow the terms and condition of the the 13<sup>th</sup> Amended Fee Schedule under the Private Healthcare and Facilities Act or any prevailing Fee Schedule adopted by the government.

It is important in the any new amendment to the Fee Schedule in Malaysia for radiologists that the reporting fee should be separate from the service of injecting contrast and monitoring any patient having an examination in the department following contrast injection . Those patients who are not stable and are considered potential risk for cardiac arrest or other complications while in the Radiology department should be accompanied by a medical officer from the ward or A& E.

Reporting on call cases after normal hours of working should also get an additional amount as per out of hours payment in the schedule. Thus in the next amended or new fee schedule it is recommended that the professional fee for reporting a case should be separated from giving contrast injection and monitoring the patient.

This means that if there is a contrast procedure needing patient monitoring the physician doing the injection and monitoring whether it be the radiologist or medical officer in the case of Teleradiology will be paid a separate fee. The physician injecting the contrast therefore would be responsible for the safety of the patient following contrast examination.

The radiologist must carry appropriate malpractice coverage.

## **B. Technologists**

The radiographers and imaging technologists must have qualifications which are approved by the Ministry of Health , Malaysia.

Under the overall supervision of the radiologist, the technologist will have the responsibility for evaluation and operation of the equipment and the applicable quality assurance program. In remote sites, technologists need ongoing feedback and supervision from the radiologist responsible for the teleradiology system's quality assurance program.

Continuing education of technologists must meet their College regulations. Sonologists performing tele-ultrasound should receive hands on experience, preferably under the guidance of the radiologist supervising the tele-ultrasound facility.

**C. Others**

Teleradiology services must have access to medical physicists, bioengineers and image communications specialists, or image management system specialists on-site or as consultants on an "as needed" basis.

## **V. GENERAL REQUIREMENTS AND STANDARDS WITH REGARDS TO TELERADIOLOGY PRACTICE IN MALAYSIA**

### **1 Equipment Specifications**

Specifications for equipment used in digital image data management will vary depending on the application and the individual facility's needs; but in all cases, it should provide image quality and availability appropriate to the clinical needs whether that need be official interpretation or secondary review. Compliance with the Digital Imaging and Communications in Medicine (DICOM) and HL7 standards are mandatory.

#### **A. General requirements**

At the time of patient imaging, the imaging modality must have capabilities for capturing demographic as well as imaging information such as accession number, patient name, identification number, date and time of examination and name of facility or institution. This information must be associated with the images when transmitted with a modality-specific information object descriptor. These fields should be formatted per DICOM standard. It is desirable to obtain this information using the DICOM modality work list services that communicate the correct information electronically.

#### **B. Compression**

Compression may be defined as mathematically reversible (lossless) or irreversible (lossy). Reversible compression may always be used, since there is no impact on the image. Irreversible compression may be used (for none than mammography) to reduce transmission time or storage space only if the quality of the result is sufficient to reliably perform the clinical task. The FDA does not allow irreversible compression of digital mammograms for retention, transmission, or final interpretation. The type of body part, the modality, and the objective of the study will determine the amount of compression that can be tolerated. There is now technology available where no compression is used and this is preferred.

#### **C. Transmission**

The environment in which the studies are to be transmitted will determine 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 should have a bandwidth commensurate with expected volumes in the ability to deliver images in a timely fashion. The transmission system must have adequate error-checking capability. Only the appropriate modality-specific DICOM service-object pair classes should be used for transmission and storage.

#### **D.Computer Monitors**

The following guidelines are to be considered:

- Medical grade monitors are preferred
- Monitors using Liquid crystal display (LCD) technology may be used. Their discrete pixels offer excellent resolution without distortion. The flat panel surfaces are able to absorb ambient light to minimize reflections and glare.
- Cathode ray tube monitors should not be used.
- Monitors using twisted nematic (TN) pixel structures technology should not be used.
- Monitors with analog video interface signal such as VGA or DVI-A is not recommended since the digital to analog conversion in the graphic controller and the analog to digital conversion in the LCD device can introduce image degradation.
- A minimum of 5-megapixel monitors are required for mammography viewing and high resolution LCD monitors for all other imaging modalities.

#### **E.Presentation software**

The application software used to select and present images studies should provide features to allow rapid and easy review or interpretation of a study.

- Hanging protocols that address the selection of image series and display format should be flexible and tailored to user preferences with proper labeling and orientation of images.
- Fast and easy navigation between new and old studies should be feasible.
- Accurately associating the patient and study demographic information with the images of the study performed is essential.
- Window and level adjustment tools must be available.
- Zoom (magnification) and pan functions capable of meeting guidelines for display at the originally acquired spatial resolutions (i.e., direct presentation of acquired pixels on the display pixels) are essential so that the display monitor does not limit the intrinsic spatial resolution of the image.
- Rotating or flipping the images must preserve the correct patient orientation labels.
- Calculating and displaying accurate linear measurements and pixel value determinations in values appropriate for the modality (e.g., Hounsfield units for CT images) are necessary, if those data are available and can be calibrated to the acquisition device.
- Prior application of irreversible compression ratio, processing, or cropping on the image and/or overlay should be indicated.
- Clinically relevant technical parameters should be accessible with overlay information on the display or with capabilities to view the DICOM header content.

#### **F.Ergonomic factors**

- Adequate air flow, optimal temperature, and humidity control should be maintained in reading areas.
- Viewing conditions should be optimized to minimize eye fatigue
- Noise from computer equipment and other devices should be minimized.
- Proper chairs with lumbar support and adjustable height controls (including armrests) are recommended to avoid injuries and excessive fatigue.
- The workstation table should be height adjustable, and the keyboard, mouse, and monitors should be designed to maximize comfort and efficiency. The display devices should be placed to maintain the viewers at an arm's length from the display (i.e., about 2/3 m or 60 cm).
- Dictation tools, internet access, and other reference tools should be readily accessible and easy to use during image interpretation.

### **G. Archiving, Retention, and Retrieval**

Digital imaging data management systems must provide storage capacity capable of storing the image for 7 years. Images interpreted off site need not be stored at the receiving facility provided they are stored at the transmitting site or its designee.

### **H. Privacy and Security**

Teleradiology practices are covered under the HIPAA privacy and security rules [2], which set standards for the electronic exchange of health information and for training, risk analysis, and security. Teleradiology providers must ensure compliance with the privacy and security rules, recognizing that teleradiology's unique nature may present compliance challenges. All equipment and transmittal interfaces should follow the security requirements mandated by HIPAA, regardless of the reading location or setting.

### **I. Image interpretation**

There are 3 important principles relevant to image interpretation:

- The importance of patient primacy;
- The requirement that all professional services and interpretations be accessible, safe, accurate, and timely; and
- The condition that the teleradiologist are responsible for the quality of all images interpreted.

Teleradiologists should be engaged, directly or in a supervisory role, in the following activities before the actual acquisition of the study:

- Selection of the appropriate imaging tests,
- Supervision of the protocoling of studies and patient preparation,
- Decisions regarding the use of intravenous contrast agents, and radiation safety.

- After the image is acquired and interpreted, the teleradiologist should be engaged in the communication of results, particularly critical findings. A teleradiology provider should always be available for consultation with referring physicians or on-site radiologists.
- Relevant Prior Imaging and Reports and Clinical Information
- Interpretations should be made with complete availability of relevant clinical information and previous imaging studies (if any).

#### **J. Physician-to-Physician Communication**

In general, communication between the interpreting radiologist and the referring physician should be readily and bidirectionally available. Pathways of easy and prompt communication should be well established, agreed upon, and facilitated by both parties. These can be in the form of telephone, smart phone and e-mail. Two major areas where the radiologists may need to communicate with the referring physicians are:

- when more clinical information is required
- when there is a need to communicate critical results

#### **K. Legislative requirement**

The most important aspect of legislation is a system that complies to DICOM standard. Transmission of images via emails or whatsapp should be forbidden. In the later, images are compressed with significant loss of resolution making them non-diagnostic.

The system should also comply to local legislation. In Malaysia, the 2 most important legislations are:

- Medical Device Authority
- Personal Data Protection Act 2010 should be followed

MDA approval ensures that the system is safe for medical use.

PDPA registration ensures that patients' data are protected and regulated.

## **SPECIFIC STANDARDS IN TELERADIOLOGY THAT ARE RECOMMENDED ARE LISTED BELOW:**

Digital imaging sent by Teleradiology will usually originate from a PACS system. In occasional circumstances, the digital conversion of hard copy or analogue images may be necessary if the transmitting site does not have PACS. The scanner used must not reduce the digital resolution below that considered an acceptable threshold as indicated in the next section.

### **A. Specific Standards**

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 current DICOM is required for all new equipment acquisitions, and consideration of periodic upgrades incorporating the enhancements recommended in 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:

1. 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 digitized radiographic films). For 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.
2. For large-matrix, the data set should allow a minimum of 2.5 lp/mm spatial resolution at a minimum 10-bit pixel depth.

These pixel depths are the standard in the absence of compression, and will need adjustment if compression is used as per the lossy compression standards when these are implemented.

### **B. Acquisition or Digitization**

Initial image acquisition should be performed in accordance with the appropriate CAR 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 PACS / teleradiology system. The DICOM standard must be used.

#### **2. Secondary image capture**

- a. Small-matrix images: Each image should be digitized to a matrix size as large as or larger than that of 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 corresponding to 2.5 lp/mm or greater, measured in the original detector plane. These images should be digitized to a minimum of 10bits pixel depth.

These pixel depths are the standard in the absence of compression, and will need adjustment if compression is used as per the lossy compression standards when these are implemented.

### **C. Mammography, Fluoroscopy and Ultrasound**

#### **1. Mammography:**

Digital Mammography is evolving rapidly. Teleradiology provides an ideal way to get the images reported by radiologists trained in mammography.

#### **2. Fluoroscopy:**

At present the standard for fluoroscopy is to have a radiologist performing the examination. If physician extenders are to be utilized in the future, it is also recommended that there is a supervising radiologist on-site. There may be exceptions when fluoroscopic images can be transmitted for interpretation via teleradiology.

#### **3. Tele-Ultrasound**

A radiologist must be available for consultation with the sonographer on a case by case basis. Ideally the radiologist should be on-site and available to participate actively in the ultrasound examination when required. It is recognized however that the geographic realities in Malaysia do not permit the presence of an on-site radiologist in all locations.

Adequate documentation of each examination is critical and should include sonographer annotations and if necessary video clips. As with all aspects of teleradiology, the reports must be timely and the radiologist must be available by telephone for consultation with the sonographer and the referring physician. The radiologist should visit the facility on a regular basis to provide on-site review of ultrasound procedures and sonographer supervision.

### **D. Image Management**

Most teleradiology systems are now PACS systems with network connections with a few remaining point to point systems. All systems shall include an integrity checking mechanism to ensure that all transmitted information from the site of origin is received intact by the reviewing site as well as:

- a. Capability for the selection of the image sequence for transmission and display at all the reviewing sites.
- b. The patient must be identified accurately and unambiguously. This may include patient name, identification number, date and time of examination, film markers,

institution of origin, type of examination, degree of compression (if used) and a brief patient history. This information should be bundled with the image file but may also be transmitted by other secure means e.g. fax.

c. Capacity to obtain prior examinations and reports.

d. The issue of compression is currently under investigation by members of the CAR PACS / Teleradiology committee who hope to define and recommend compression levels for varying modalities. In the interim compression should be used judiciously.

e. Image storage at either the acquisition or reviewing site as well as transmission must be arranged such that patient confidentiality is maintained and that the system is secure.

f. The provider must ensure that the image quality is the same at the acquisition site and reviewing site(s).

### **E. Transmission of Images and Patient Data**

Communications protocols, file formats and compression shall conform to the current DICOM standard. There should be provision for the selection of appropriate compression for improved transmission rates and reduced archiving/storage requirements. There must be no reduction in clinically diagnostic image quality. The types and ratios of compression used for different imaging studies transmitted and stored by a system must be selected and periodically reviewed by the responsible physician to ensure appropriate clinical image quality.

### **F. Display Capabilities**

Display workstations employed for teleradiology / PACS systems must provide the following characteristics:

1. Luminance of the gray-scale monitors of at least 50 foot-lamberts.
2. Display stations must accurately reproduce the original study and must include:
  - a. brightness and contrast and/or interactive window and level function
  - b. a magnification function
  - c. the capability of rotating and flipping the displayed images
  - d. the capability of accurate linear measurements and CT Hounsfield units
  - e. the capability of inverting the gray-scale values of the displayed image
  - f. the capability to display clinically relevant parameters

### **G. Patient Database**

For radiological images transmitted by PACS / Teleradiology, a database must be available that includes.

1. patient name, identification number and date
2. type of examination e.g. Chest
3. modality e.g. CT, MRI etc.
4. number of images
5. image acquisition site
6. date and time of acquisition and availability for review

## **H. Security**

Teleradiology systems must provide network and/or software protocols to protect the confidentiality of the patient's record(s), image(s), interpretation(s) and other data and insure that the system is secured and used only on an as needed basis by those authorized by the patient in accordance to local privacy of information legislation.

## **I. Reliability and Redundancy**

Quality patient care may depend on timely availability of the image interpretation. There should be an internal redundancy system, backup telecommunication links, and a disaster plan.

## **J. STORAGE OF RECORDS**

The legal requirements for the storage and retention of images and reports will vary from country to country and the providers of the teleradiology service are responsible for adhering to these requirements.

Images stored at either the acquisition or reviewing site shall meet the jurisdictional requirements of the acquisition site. Images interpreted off-site need not be stored at the reviewing facility provided that they are stored at the acquisition site. The policy on record retention should be in writing and may in part reflect the accreditation requirements of the two facilities involved.

## **K. DOCUMENTATION**

Communication is a critical component of teleradiology. Radiologists interpreting teleradiology examinations shall render reports in accordance with the CAR Standard of Communication.

## **L. QUALITY CONTROL FOR TELERADIOLOGY**

The interpreting radiologist has to ensure that the quality of the images being reviewed is of acceptable standard.

It must be stressed that the images at the reviewing site can only be as good as the images generated at the acquisition site. It is imperative that a radiologist should visit the acquisition site on a regular basis to ensure that the equipment is functioning properly and that the technologists are adequately supervised and trained.

Both the acquisition and reviewing sites must have documented policies and procedures for monitoring and evaluating the effective management, safety, proper performance of imaging, transmitting, receiving and display equipment.

The quality control program should be designed to minimize patient, personnel and public risks, and to maximize the quality of the diagnostic information. Equipment performance must be monitored at intervals consistent with proper quality control.

Important parameters must be accompanying the transmitted study when used for the official authenticated written interpretation. These will include, at a minimum, the matrix size, bit depth, compression (if used), and what kind of image processing, if any, was used (edge enhancement etc.).

A radiologist must be involved in the selection of imaging systems at both the reviewing and acquisition sites. In this period of fiscal restraint, it is important to ensure that the scarce healthcare resources are used to acquire diagnostically acceptable equipment, which has been approved by a duly qualified diagnostic imager.

#### **M. QUALITY IMPROVEMENT**

The use of teleradiology does not reduce the responsibilities for the management and supervision of diagnostic imaging.

Procedures must be systematically monitored and evaluated as part of the overall quality improvement program of the facility. Monitoring shall include the evaluation of the accuracy of the interpretations as well as the appropriateness of the examination. Incidence of complications and adverse events must be reviewed to identify opportunities to improve patient care.

With the increasing use of PACS technology, radiologists should ensure that institutions identify and train PACS administrators (image management specialist). Their responsibilities would include the monitoring of quality and confidentiality of transmitted images and to maintain a viable system.

The increased use of networking also allows for remote auditing and peer review when required.

#### **CONCLUSION :**

A preferred teleradiology service would be:

- Patient and physician centered (as opposed to technology centred).
- 'No Compression' technology is used.
- Comply to DICOM Standard Compliant.
- Image storage facilities are secured and well-protected.
- Web-based (as opposed to PC-based) radiologist portal for viewing and reporting.
- Cloud technology (as opposed to server) for storage of images.
- Registered with Malaysian Medical Device Authority
- Registered with Personal Data Protection Act 2010

## **GLOSSARY OF TERMS USED IN THIS DOCUMENT:**

ACR/NEMA - the American College of Radiology and the National Electrical Manufacturers Association

Bit (Binary Digit) - the smallest piece of digital information that a computing device handles. It represents off or on (0 or 1). All data in computing devices are processed as bits or strings of bits.

Canadian IHE – Integrating the Healthcare Enterprise. A national vision of a connected and interoperable healthcare infrastructure

Data Compression - methods to reduce the data volume by encoding it in a more efficient manner, thus reducing the image processing and transmission times and the storage space required.

DICOM (Digital Imaging Communications in Medicine) - a standard for interconnection of medical digital imaging devices, developed by the ACR/NEMA committee.

Digitize - the process by which analog (continuous wave) information is converted into digital (discrete value) information. This process is a necessary function for computer imaging applications because visual information is inherently in analog format and most computers use only digital information.

Gray Scale - the number of different shades or levels of gray that can be stored and displayed by a computer system. The number of gray levels is directly related to the number of bits in each pixel: 6 bits = 64 gray levels, 7 bits = 129 gray levels, 8 bits = 256 gray levels, 10 bits = 1024 gray levels and 12 bits = 4096 gray levels.

K (Kilo) - stands for the number one thousand (1,000). It is used primarily when referring to computer storage and memory capacities. E.g. 1 Kbytes = 1024 bytes.

Lossless - no loss of the original digital information upon reconstruction of the digital image.

Matrix - an image formed by distinct points in both the horizontal and vertical directions. E.g. a 512 matrix is made up of 512 points in one axis and 512 points in the other.

PACS – Picture Archival and Communication System

Resolution - the ability of an imaging system to differentiate between objects.

Sonographer - a technologist approved by the regional licensing body to perform diagnostic ultrasound services

The following resources and articles were used to prepare the above document:

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