



Principles for the Provision of Digital Diagnostic Images

Digital imaging technology is rapidly being introduced with substantial benefits to patients, referring practitioners and diagnostic imaging practices. These benefits cannot be realised unless all those affected are willing and able to adapt and accept that change is necessary.

The current dissatisfaction of some referring and treating practitioners with the quality of the electronic images and the mode of their delivery demonstrates that there needs to be a greater emphasis on standards, professional collaboration and understanding of the impacts of change when new technologies are being introduced.

To address the immediate specific concerns of some referrer practitioners, the RANZCR and ADIA have developed the following principles, which should guide the practice of radiologists, diagnostic imaging practices and other health services producing digital diagnostic images, whether or not they are members of the RANZCR or ADIA. These guidelines will be offered to other professional bodies for comment, endorsement, and presentation as a joint statement.

❖ Provision of diagnostic images:

Diagnostic imaging examinations should result in a radiologist medical opinion and provision of diagnostic quality images, either on film, online, or by using standard digital media. A referring or subsequent doctor, or the patient him- or her-self, is entitled to request images in a form suitable for viewing in their particular circumstances. Until processes for reading and management of digital images are widely implemented, this may involve printing images on film, if requested, during an agreed transition period.

Film is becoming obsolete and inadequate for presentation of complex imaging data sets. It is an expensive, inefficient and environmentally poor medium for transmission of diagnostic imaging, now that digital alternatives are available. With the move to digital radiology practice, film is not used routinely in the process of diagnostic imaging, hence the trend to delivery of images by digital methods on portable media, or by the internet. These changes in technology must however be managed to ensure that those affected have the opportunity to adapt, and that there is no adverse impact on patient healthcare or inconvenience for the other health practitioners involved in their care. Clearly this transition period cannot be open-ended, and a reasonable period for the management of change will be agreed to through consultation.

Digital images offer a superior solution for complex imaging data sets, and broader benefits include timeliness of delivery, availability, comparison, ease of transport, and handling. Many practitioners are showing a preference for digital delivery of multi-slice or volumetric images, however the view of several professional societies is that digital plain x-rays are currently better delivered on film, as adequate equipment and software support for templating are not yet widely available. A useful change management strategy for those imaging practices wishing to provide images on portable media (such as CDs) would be to focus on digital delivery of cross-sectional imaging initially, with or without film copies, as required by the referrer.

Regardless of how the image set is delivered, it must be of high quality and specific attention is required to provide:

- documentation or display of magnification (so-called “true size”)
- location or scout views where multi-slice images are provided
- documentation of any image compression used
- indication as to which images are of diagnostic quality, as this is not always apparent to the end user

Imaging services often assess the media requirements of the referring doctor, and may assess whether a downstream referral to a particular specialist type is likely from the referral notes or assessment of image findings. This may result in provision of specific views and image media required for patient care, however, given that the pathway of images cannot be reasonably predicted in all cases, subsequent requests for reproduction of images in digital or film formats may be received from treating doctors. Consequently the practices of routinely requesting or performing investigations where the reason for referral is “unsuitable image format”, without other clinical need, are to be strongly discouraged, as they constitute doubtful ethical practice (as it involves avoidable radiation exposure), and are likely to be in breach of Medicare regulations (if a rebate is requested).

While it can be difficult to define a diagnostic quality image in all situations, a reasonable guide is an image set that is comparable in quality and media presentation to that used by the radiologist in reporting on the examination. For film this means a 100% scale image with sufficient images to cover the intent of the request. For digital imaging, the full DICOM dataset should be provided. Illustrative image sets (which may be in compressed/non diagnostic formats such as JPEG) are useful adjuncts to provide easily accessible images to support a more user friendly interface for some practitioners, and for consumer education. Such illustrative (non diagnostic) image sets could provide key images or a reduced study set based on image reconstructions at conventional thickness (as would have been used for rendering cross sectional studies on film). Many practices are also adopting the useful practice of providing illustrative and/or key image prints on paper which further supports consumer education by referrers.

❖ **Electronic transmission of images and a radiologist medical opinion:**

Where the radiologist medical opinion and image are delivered electronically by portable media, on-line or other means, appropriate Australian implementations of international standards and profiles will be used to enable the efficient and reliable receipt and interpretation of these images.

Compliance with standards is essential to enable image viewing systems to reliably decode and render diagnostic quality images. One practitioner and their local information system may be expected to process images sourced from multiple different imaging services, which in turn will be using many different implementations of a range of imaging hardware and software.

Standards Australia (www.standards.org.au) describes the local implementation of HL7 version 2 messaging, covering electronic referral and requests, and the acknowledgement messages (indicating both receipt of the message, as well as processing by the receiving system). Adherence to these standards can be required in purchasing specifications and should be verified by reference to a vendor conformance statement supported by testing at the Australian Healthcare Message Laboratory (AHML) or IHE Australia connectathon.

For images on portable media (such as CDs, DVDs or USB drives) the requirements for diagnostic quality imaging are described in the Integrating the Healthcare Enterprise (IHE - www.ihe.net) Portable Data for Imaging (PDI) profile, as localised for use in Australia by reference to RANZCR/ADIA technical experts. Cardiology image management has a specific set of IHE standards and profiles. Radiology services should ensure that their IT vendor has a current IHE compliance statement, and that they have their practice media

such as CDs tested for compliance annually as problems do occur at the local implementation level and after software upgrades. Portable media will be adequately labelled, provided with printed and electronic user instructions, and packaged to support appropriate care of the media, and inclusion of other materials such as radiologist medical opinions, sample film or paper printouts. Details of these requirements will be included in the RANZCR Standards of Practice V9, due to be published by June 2008.

The data provided electronically with the report, should enable referring or treating practitioners to view the images at the same level of quality as occurred during the radiologist reporting process, and to support the use of post-processing such as templating and reconstructions.

❖ **Viewing of digital images:**

In order to view diagnostic quality images electronically, referrers and treating practitioners will require computer systems of suitable specification, and will need experience in using digital images. The workflow and patient management may also need to be adjusted to ensure that the images are available to the treating clinician where and when required.

The RANZCR and ADIA will work collaboratively with health professionals and other stakeholders to understand clinician requirements, and provide appropriate technical guidance on issues such as monitors for image display. As an initial guide, a monitor used for display of CT and MRI images needs to be of 300 cd/m² luminescence and 768x1024 resolution (without Grey Scale Calibration). High quality 2 mega-pixel monitors (1200x1600) are now available for business use, and may be suitable for display of plain x-ray images. Higher quality, higher resolution monitors are needed for specialised reporting such as digital mammography. Grey scale calibration, and use of appropriate IHE profiles, will support consistent display of images, and is recommended for systems and monitors used regularly for diagnostic purposes.

Practitioners who regularly use images for diagnosis or planning of treatment are advised to acquire their own DICOM image display software. DICOM viewers provided on media by radiology practices are not often certified by the manufacturer for diagnostic purposes, as the manufacturer cannot vouch for the quality of monitors being used with the viewer. These proprietary embedded viewers do not have a consistent user interface, which creates usability and safety issues for referrers, due to the difficulty of potentially maintaining familiarity with 10-15 different viewers.

The radiology profession is encouraged to work with technical experts from the procedural specialities to provide guidance on functional requirements and identification of products which may be suitable for a specific specialist group. The IT industry is encouraged to provide suitable products at an affordable price to medical practitioners to support image viewing and post-processing. There are a range of excellent freeware or commercial software products which can be downloaded and installed on appropriate hardware for those who wish to create their own solutions. Therapeutic Goods Administration (TGA) listing (Class 1B) is required for a combination of hardware and software used for making measurements from diagnostic images (whether purchased as a commercial product, or constructed locally from hardware and software components).

Practitioners who wish to view images for education or illustrative (non-diagnostic) purposes are encouraged to use their web browser to view standard (non-DICOM) image formats, or alternatively to use the embedded viewer (if they wish to cope with the complexity of this interface). Paper print-outs of images can be very helpful for education or illustrative purposes, however are not suitable for diagnostic use.

Images delivered on portable media, or over the internet (unless streaming technology is used) take a variable amount of time to load. For occasional use this may not be a problem, however when electronic images are used regularly, this time lag is usually unacceptable. One solution is to pre-load the images while the patient is in the waiting room, and the images can then be accessed from the computer disk storage.

Alternatively, images can be pre-loaded by the practitioner early in the consultation, and prior to the point of the consultation where images need to be reviewed. Loading time is longest with CDs and DVDs (depending on how much data is required) and is less with solid state drives, such as USB or SD cards, however the latter are not yet widely used for this purpose, and may not be practical for general use for some time to come.

❖ **Digital Image Storage**

Consensus with both referrer and provider craft groups regarding the length of time and content of the data archived needs to be developed during this transition period. Opinions in relation to image archive retention range from 6 months to 2 years depending on the nature of the examination and the needs of the patient. Formal consensus on archive retention will need to be reached but in the meantime imaging providers may need to establish a 6 month archiving period for all examinations, and referrers may need to advise imaging providers of any additional requirements.

The practice of storing only the radiologist medical opinion with or without illustrative images (on media, or film/paper printout) is not supported as good practice and also conflicts with other parts of this principles document.

There are well known situations in both radiology and specialist practice where review of prior images is a key element of the diagnostic process. The issue of image storage is profoundly affected by the technological changes with digital imaging. User requirements and imaging practice capacity needs to be further clarified. Portable media are currently used for long term storage by some practices that have not yet migrated to the use of image archives. These media are potentially subject to being misplaced or damaged. Good practice in the IT industry would not support the practice of archiving critical data onto a portable media format as the only storage method during the period where the image is needed for immediate patient management. Standards and legal requirements vary considerably with different locations, diagnostic imaging settings, and patient specific factors. Where images are archived to portable media this should be reflected by appropriate media storage, labelling and instructions. The time period of 18 months has been identified as being consistent with the minimum retention period for radiologist medical opinions for Medicare purposes but this will need to be revised after further consultation with all parties.

❖ **Next Steps:**

The technology for creating and managing digital images is evolving and it is recognised that CDs and portable media are most likely a step in the direction of a standards based web access service, providing open access to images for radiologists and treating doctors with patient consent.

This document will be offered to appropriate specialist colleges and organisations for discussion and revision prior to being adopted jointly with the RANZCR and ADIA and updated as required to address evolving issues and changes in practice. The principles will be reviewed in 2 years (May 2010), particularly with regard to the requirement for ongoing delivery of images by film by request. A reasonable period for implementation of specific elements of the principles will be agreed and appended to the final version.

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