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# Towards Delivery of Digital Diagnostic Imaging – Collaboration to Reach a Solution

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## Abstract

### *Objective:*

To manage the transition from film to digital media in medical Diagnostic Imaging (DI), ensuring that the needs of consumers, clinicians and providers are addressed.

### *Background:*

Traditional X-ray film is being replaced by digital media such as CDs. While CDs are reliable and cost-effective, their introduction has resulted in significant difficulties for, and complaints from, referrers.

In response, in 2007, the Quality Use of Diagnostic Imaging (QUDI) Program commissioned two projects to address difficulties associated with diagnostic images provided on CDs.

### *Methods:*

Following Integrating the Healthcare Enterprise (IHE) methodology, we defined the problem, identified possible solutions, and engaged peak professional bodies to support changes in practice. A "CD Challenge" was a key step in raising awareness and defining the extent of the problem. A workshop was convened to further engage users, referrers, and industry. Appropriate standards were identified and integrated into proposed workflows. Relevant testing standards were identified, and are being implemented at a connectathon.

Agreed standards and procedures have been defined in a Code of Practice for digital image transfer in DI.

### *Results:*

The CD Challenge found suboptimal labelling, long loading times, great variations in supplied viewing software, and many errors in DICOM usage. The IHE profile for Portable Digital Imaging was adopted for use in Australia, with some proposed Australian extensions, and CDs will be tested for compliance at this meeting. A Code of Practice was developed to support DI practices in transferring digital images to their referrers, using the PDI profile, and some additional guidelines.

### *Discussion:*

Although some significant local issues were not addressed by the relevant IHE profile, the IHE process has provided a systematic and inclusive process to develop a solution that will support better health outcomes for all consumers of DI services. Challenges remain in ensuring ongoing compliance with the Code of Practice.

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## *Keywords:*

Integrating the Healthcare Enterprise; Digital Images Standards, Portable Media, CDs, Radiology Informatics

# Full Paper

## *Objective:*

This project aimed to develop a Code of Practice that would facilitate the transition of the medical diagnostic imaging industry in Australia from film-based image transfer to image transfer on digital media, while addressing the needs of all stakeholders (patients, referrers, and imaging providers).

## *Background:*

Diagnostic Imaging (DI) is the generic term for medical tests which produce a visible image of some aspect of the patient's anatomy. It originated with plain radiographs ("x-rays"), but since the 1960s has expanded rapidly, with the development of nuclear medicine (scintigraphy), and the addition of ultrasound, computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET). Medicare Australia paid over $1 billion in rebates for diagnostic imaging studies in 2006-7.

Traditionally, diagnostic images have been recorded on silver halide film, and viewed on a simple light-box (ie, with the film mounted on a diffusing screen in front of a bright light). Developments in imaging technology have led to a massive increase in the numbers of images acquired in some studies, and have also allowed (or in some cases required) the replacement of relatively expensive film by more cost-effective electronic detection techniques. As a result, there has been a strong trend towards the delivery of medical images in digital format, on compact disks (CDs). CDs offer a cheaper and more compact image transport medium, and also allow more efficient and interactive viewing of the large and complex image sets produced, for example, by modern multi-detector row CT scanners.

This trend has met strong resistance from some referrers, on several grounds:

- viewing equipment may not be available at the site of consultation ;
- some CDs will not load on the available equipment;
- software supplied on the CD may be incompatible with that on the available hardware;
- CDs take too long to load and view
- images supplied may not be of the same quality as those provided previously, or those used by the radiologist in dictating the official report

In early 2007, referrer resistance evolved into a political campaign for changes in Medicare regulations that would have required DI practices to provide all images on film.

Diagnostic imaging equipment vendors internationally had anticipated that there would potentially be interoperability problems between image CDs and the various hardware and software platforms that might be used to view them, and under the aegis of the IHE consortium developed a profile designed to ensure that compliant CDs could be viewed on any platform (IHE, revised 2007).

Nevertheless, problems similar to those described above have been encountered overseas. At a recent global radiology meeting, Mildenberger (2006) presented the results of formal testing of CDs by the German Radiological Society and Offis. The large majority of CDs were found to be not compliant with the PDI profile, in many cases because of relatively simple errors in the use of DICOM, the standard file format for medical images.

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We decided to conduct a similar exercise in Australia, to test the extent of compliance of DI CDs on the Australian market, raise the profile of the issue with radiology practices, and highlight the existence of relevant standards and profiles. The results of CD testing, and of stakeholder consultation, were used to develop a Code of Practice to guide DI practices in the appropriate introduction and use of the new media.

## *Methods:*

### DEFINING THE PROBLEM:

CD Challenge Materials – CDs : An "Australian CD challenge" was issued to radiologists and others attending the annual scientific meeting of the Royal Australian and New Zealand College of radiologists (RANZCR) in October 2007. Conference attendees were challenged to submit a CD containing anonymised image data from a CT scan of the brain and a chest X-ray for testing against the IHE PDI profile. Attendees submitting CDs were placed in a draw for a small prize, and a second draw was proposed for those whose CDs were indeed compliant.

### CD COMPLIANCE TESTING:

The presence and nature of any CD labelling was assessed by visual inspection. CDs were loaded onto systems running each of Windows XP, Vista, Mac OS, and Linux, and the time taken to load noted. Compliance of the CDs' file systems with the IHE Profile was tested with software tools from IHE (MESA tools) and the Oldenburg Research and Development Institute for Information Technology Tools and Systems (OFFIS, a partner of the German Radiology Society)

### STAKEHOLDER CONSULTATION AND ENGAGEMENT OF PEAK PROFESSIONAL BODIES:

After a series of preliminary meetings, a national workshop was convened to discuss the problems, and develop acceptable solutions. Industry, referrers, radiology practices, and state and federal governments were all well represented. The results of a membership survey by the Australian Orthopaedic Association were made available to the project team.

### IDENTIFYING SOLUTIONS:

Standards selection and integration: Review of the literature, particularly the German experience, led to the identification of the IHE profile for Portable Digital Imaging, and the standards on which the profile draws, as the bases for a workable solution. This had the important advantage that much of the integration and harmonisation of different standards had already been done. We were fortunate that IHE representatives were able to attend the national workshop, and provide valuable guidance in the application of IHE principles.

### TESTING STANDARDS AND IMPLEMENTATIONS:

Nevertheless, the profile, with the necessary local extensions, needs to be tested in the Australian environment, and planning is well advanced for a formal connectathon to be conducted for this IHE profile in Australia this year. This will be another key step in the development of IHE activities in Australia. Beyond the certification of products tested at the connectathon, it will be necessary to provide an ongoing testing service to assure practices that their CDs are fully compliant, and that their vendors have fully implemented all aspects of the Profile and associated standards.

### ENCOURAGING ADOPTION:

An important outcome of the stakeholder workshop was that it was agreed that an industry Code of Practice be developed to set out what was required of each stakeholder group, in order to make digital image transfer work. It is intended that this Code will be subsumed into the RANZCR's accreditation standards, from where it may be taken into the Federal Government's impending mandatory standards (compliance with which is required for receipt of Medicare subsidy of diagnostic imaging procedures). Hospitals and radiology practices will also be encouraged to require compliance with the IHE Profile and the Code in their tenders for new equipment.

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## *Results:*

**CD CHALLENGE:** In general the labelling of the 33 submitted CDs was poor, but this was at least partly due to the 'trial' nature of the exercise. Labelling is not currently part of the IHE profile.

All of the CDs loaded on Windows and Mac systems, but images on 7 CDs could not be viewed on the Mac system. Load times ranged from 45 to 90 seconds, with a few CDs requiring further substantial time to load further images from the same study.

Almost all of the CDs auto loaded on Windows (against the IHE recommendation), with a total of 13 different viewers encountered. Problems were encountered both with lack of administrator rights (to load the viewer) and missing software components (with Vista).

None of the 33 CDs submitted were fully compliant with the IHE profile, as tested by the OFFIS tool. Two passed the MESA assessment. Most of the failures to comply were related to errors in the use of DICOM, often relatively simple ones, as also found in the German experience (Mildenberger 2006).

**CODE OF PRACTICE:**
These results were a powerful stimulus to the development of the Code of Practice over three months of further negotiations. At this writing, the RANZCR is in the process of integrating the Code into its Accreditation Standards. The Federal Government is currently considering whether it views the Code as a sufficient response to the issues raised with the Department by referrers.

In the meantime, the first Australian connectathon testing of the PDI profile is taking place at this meeting.

## *Discussion:*

The IHE process has led to much better understanding by each stakeholder of other stakeholders' needs, and to an evolution towards a consensus on how to move forward. Not all of the issues raised by referrers were directly addressed by the available standards and IHE profiles (eg CD labelling, use of DVD or USB media), but the IHE process facilitated the development of appropriate requirements for the Code of Practice.

Challenges remain in implementation, and in ensuring ongoing compliance. The establishment of a compliance testing mechanism for CDs, potentially forming part of the diagnostic imaging accreditation program, is under consideration.

The Code of Practice will facilitate the diagnostic imaging industry's move to more efficient image transfer, and, importantly, has laid the basis for future collaborative efforts to further improve the health informatics infrastructure, in the interests of providers, referrers, and most importantly, patients.

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