

Delivery of Digital Diagnostic Imaging : Collaboration to Reach a Solution

**Nick Ferris^{1,2}, Peter MacIsaac³, Vince McCauley⁴,
Chris Lindop⁵, Marco Eichelberg⁶, Jane Grimm²**

**¹ Staff Radiologist, Peter MacCallum Cancer Centre,
East Melbourne**

**² Technical Reference Group, Quality Use of Diagnostic
Imaging Program, RANZCR**

³ MacIsaac Informatics, Yarralumla, ACT

⁴ McCauley Software Australia, Rozelle, NSW

⁵ GE Healthcare, Milwaukee, USA

⁶ OFFIS Institute, Oldenburg, Germany



Medical Images (X-rays, CT scans, etc) on CD (instead of film)

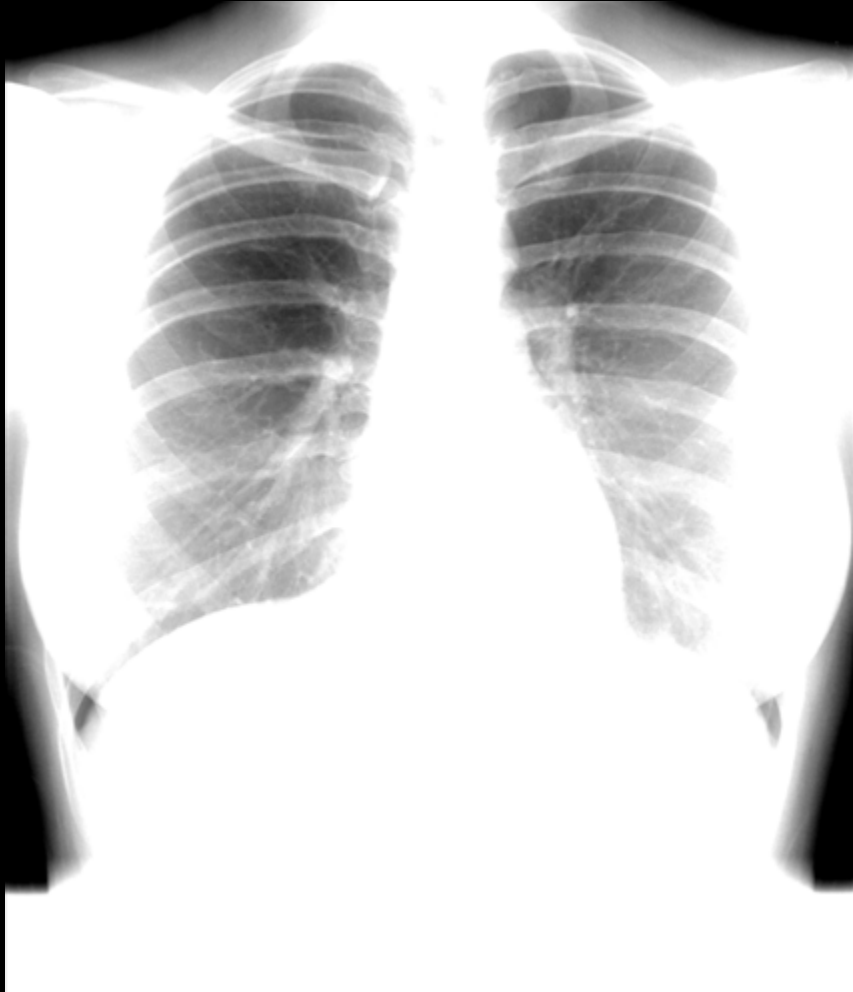
- “The move ... to supply x-rays on compact disc has been badly implemented to the potential detriment of patient care”
- “At present this means good quality films are required for all imaging investigations”

ASOS / AOA Press Release, 10/11/2006

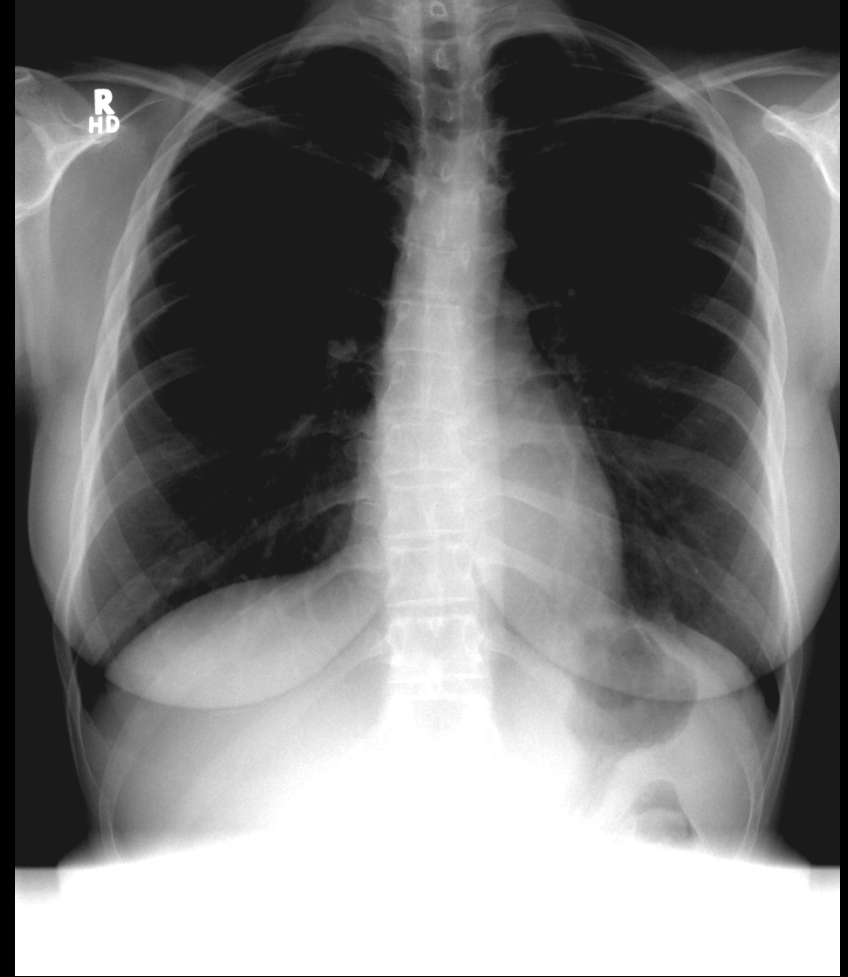
Digital Revolution in Imaging

- Radiology started by exposing analog film to X-rays
- Now almost entirely *electronic detection and digital manipulation*
- Printing images from electronic display onto film becoming anachronistic (and expensive)

Why Digital Imaging ? - I

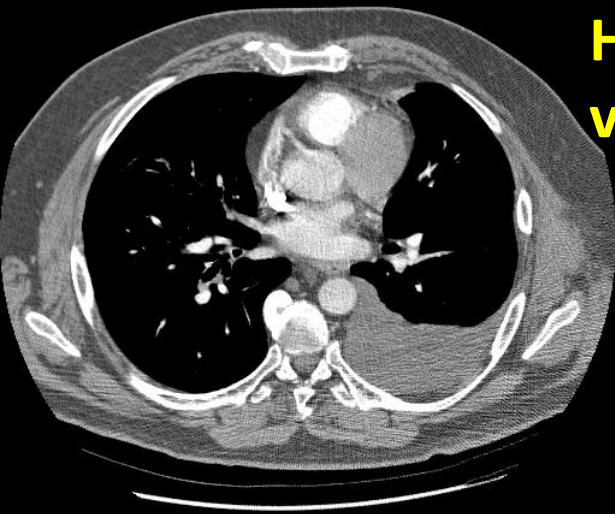


CXR : 'Underpenetrated'
Can see lungs, nothing else



CXR : 'Windowed' digital display
- 'reveals' heart and vertebrae

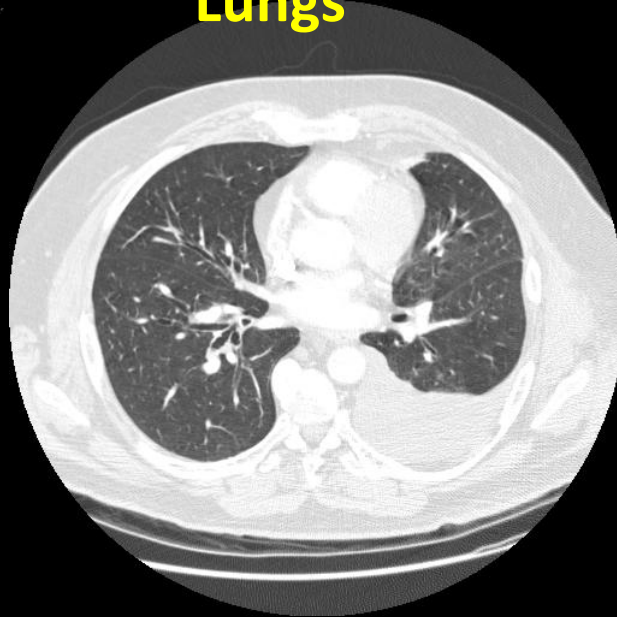
Why Digital Imaging ? – II



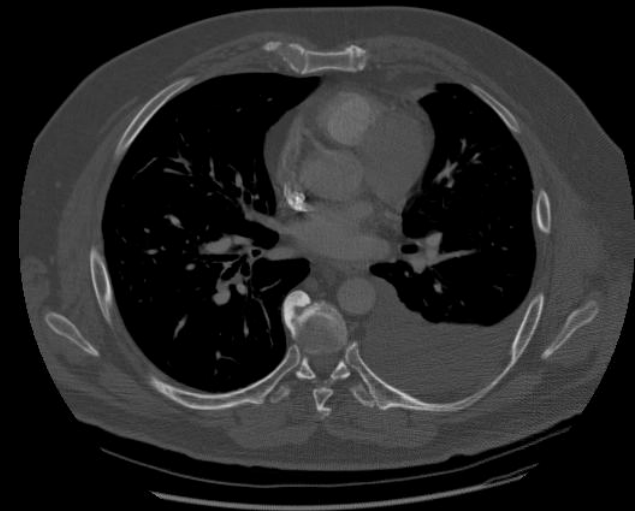
Heart & great
vessels

One cross-sectional
CT image

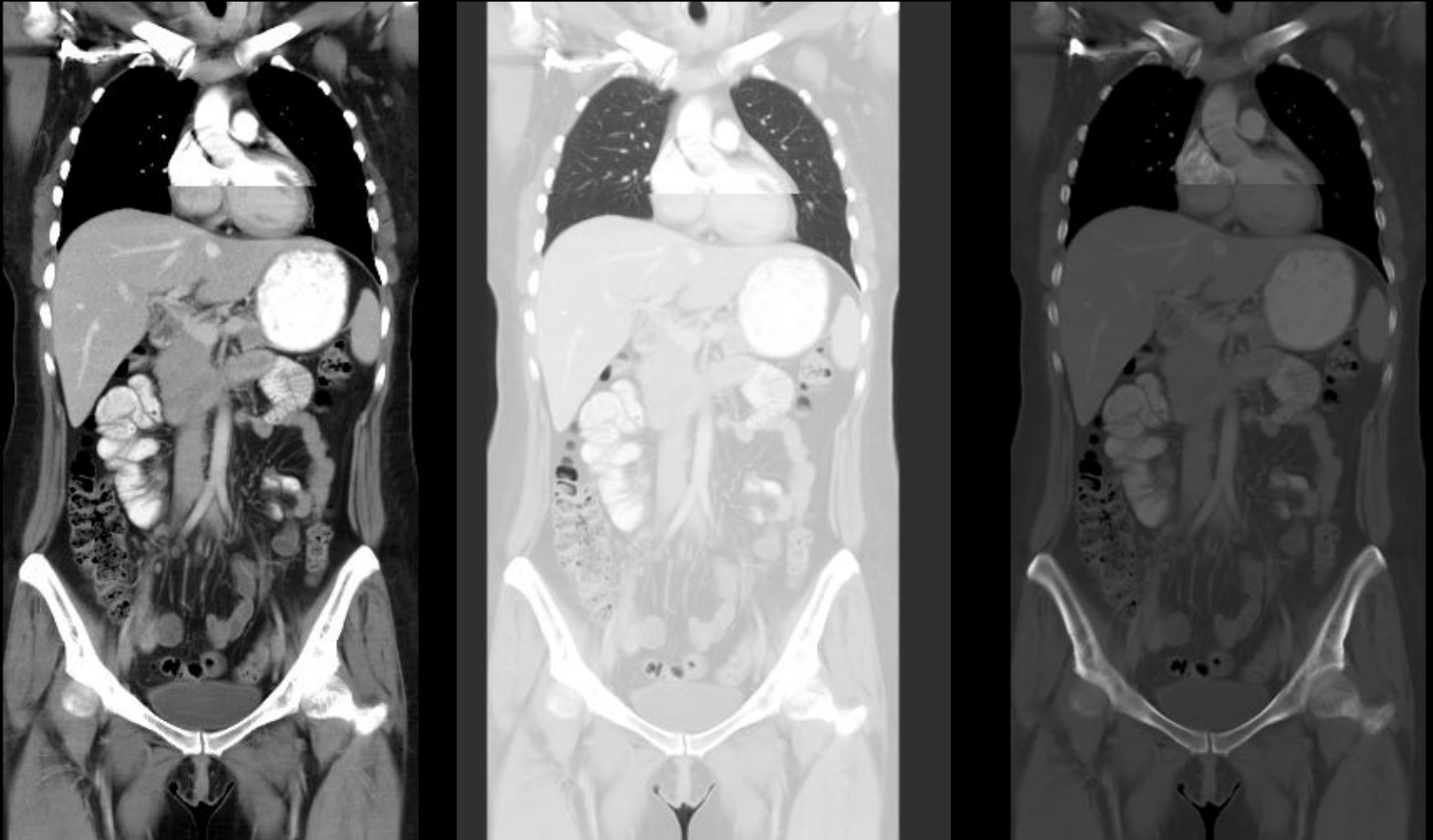
Lungs



Bones



Why Digital Imaging ? - III



**Combine 100s (or 1000s) of thin cross-sectional images into 3-D model
- reformat and window as desired.**

Downside – Moving the data

- On film, routine oncology staging with CT (20 format, full-size 35 x 43 cm film) :
 - 2-3 sheets for lungs
 - 6-7 sheets for 'soft tissues'
 - 2 sheets for liver
 - 6-7 sheets for bones
- +/- 4-5 sheets for neck, 6 sheets for brain
- => ie, *up to 30 films per exam*
and compare with previous !

How to send (so many) images ?

Inside large institutions (mostly hospitals) :

PACS (Picture Archiving & Communication Systems)
- electronic storage and networked access

To the community :

Film (selected) images
Portable digital media

- eg CD : a cheap, widely used transfer medium
=> widely used also by PACS vendors

Yes, but....

- “There’s no computer in my rooms and/or operating theatre”
- “I can’t open the CD”
- “I’ve got 15 patients to see in 3 hours, and the CD takes 5 minutes to load...”
- “How do I window with this viewer?”
- “How do I compare this CD with the last one?”
- “They’re only good for drinks coasters...”

...referrers/customers not happy !

- “...film must remain the principal means to provide images to the treating practitioner”
- “CD are an entirely inappropriate medium”
- “Must load in < 5 seconds”
- Must provide film to be eligible for rebate

There *are* problems

- Numerous complaints from referrers
(GPs, gastro-enterologists, neurosurgeons,
orthopaedic surgeons, and others)

and radiologists

and patients (sent for repeat tests)

- Became political issue :
 - media releases
 - lobbying of AMA, DoHA, Minister
- Calls for legislative action and
economic penalties
to enforce provision of film

- “...potential gains may be offset by poor implementation strategies and inadequate attention to problems”

Georgiou et al, paper # 22, HIC 2008

Addressing the Issues

- Referrer engagement : Define the problems
- Identify relevant “use cases”
(numerous and not similar)
- Identify relevant (existing) standards
- Identify (or develop) technical solutions
- Test the proposed solutions

Some “use cases”

- Send report & simple jpeg for GP to show to patient
- Send full DICOM data set of complex pelvic fracture to orthopaedic surgeon
- Lumbar spine CT to GP (? jpeg)
 - but referred on to orthopaedic surgeon...
- Images required for operating theatre
- Images at rooms A, doctor at rooms B
Etc, etc, etc, ...

Relevant existing “standard” :

RSNA 2004 - Launch of IHE PDI Profile

Portable Data for Imaging Profile (PDI)

CDs that Work!

INDEX.HTM

PDI - IHE Portable Data for Imaging RSNA 2004 Demonstration

This is a sample CD containing data

Institution/Privacy...

Web Content - Reports and Images

The following are web viewable versions of DICOM Reports and Images on this disk.

[Vendor A CR](#)

[Vendor B \(XR\)](#)

Additional Data

[What is PDI? - An Overview of IHE Portable Data for Imaging](#)

Manifest of Importable Data

This section should contain a list, or a link to a list, of all DICOM SOP instances on this disk that can be imported by a Media Importer Actor.

DICOM Viewer

This CD does not contain a DICOM viewer application. If it did, this section would contain a link to that viewer and a discussion of operating system requirements.

README File

For technical details about this disk and contact information for the source, see: [README.TXT](#)

Acknowledgements

Disclaimers

The data is for demonstration purposes only and not for diagnostic imaging. ...

←Site Configurable Title

←Site Configurable
Generic Information

←Generated Information
on CD Content and Links

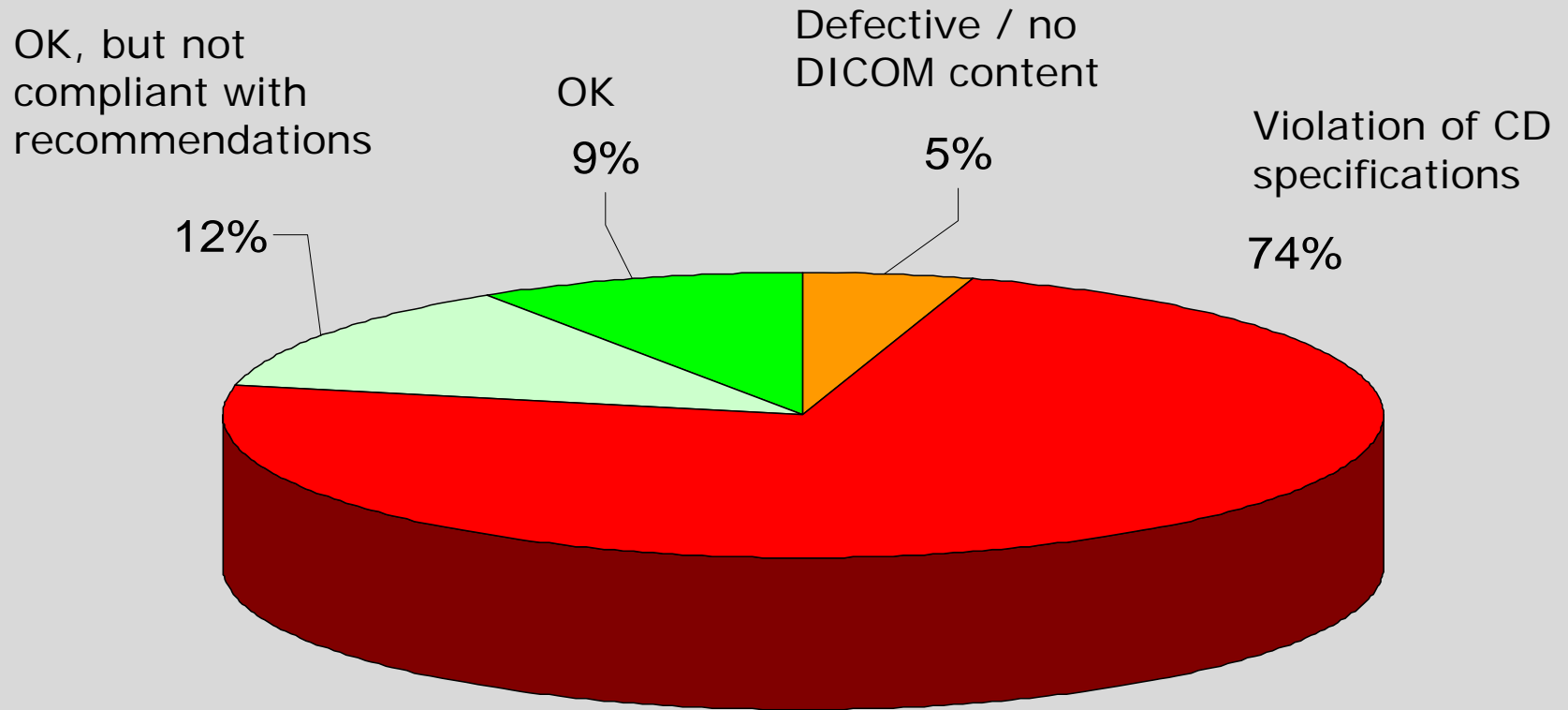
←Application Specific
Information

←Information of
DICOM VIEWER

←Link to README.TXT

←Other Site
Configurable Information

DICOM CD Tests at DRK 2006 (2)



- Test results

- **almost 80% of the tested “real world” CDs failed!**
- this clearly shows that - despite all the activities of DICOM and IHE - a quality assurance program is really needed

DICOM CD Tests at DRK 2006 (3)

- **Typical DICOM errors**
 - DICOM rules for filenames and directory names violated (beginner's mistake!)
 - missing/empty required fields in DICOMDIR
 - syntax rules for DICOM data types violated
 - incorrect transfer syntax for DICOM images (implicit VR)
- **Typical problems with the DICOM viewer**
 - required administrator privileges or does not run at all (Windows XP)
 - tries to install software components (Java or .NET runtime)
 - tries to write in C:\WINDOWS
 - cannot display all images on the CD
 - often no documentation, no manual
- **CD labelling often missing, almost always incomplete**
- **In summary, most of these problems would be easy to avoid for the software vendor**

The Great Aussie CD Challenge (2007)

- Practices invited to present CDs for testing
 - IHE profile and relevant standards
(using MESA (US) and Offis (German) tools)
- 33 CDs submitted - all failed
 - many still readable, with varying difficulty

What were the problems ?

- DICOM errors
- Viewer - required administrator rights
and/or missing software elements

13 different viewers encountered

- Labelling not formally assessed (but poor)

=> Readily fixable

IHE Australia Workshop, Dec 2007

- Wide stakeholder participation
 - referrers, imagers, vendors, regulators, patients
- IHE PDI profile in the Australian context
- Local extensions & other requirements
- Began work on consensus statement

Harnessing the IHE Process

- “Ready-made” profile and standards
- Engage local vendors, imaging providers & referrers
 - ? Local extensions :

Labelling and storage

Readme.txt mandatory

Greater use of Web content

? Orthopaedic Templating

- But need to promote use of the Profile :

Connectathon

Exploration of a testing service

IHE Connectathon, July 2008

- Vendors tested products
 - compliance with IHE profiles
 - demonstrate interoperability with other vendors, equipment
- Independent witnesses
- Only positive results published

IHE Interoperability Showcase

- Successful vendors demonstrate product (and interoperation) at IHE Showcase
- HIC 2008 (Aug 31 – Sept 2), Melbourne
- Several successful implementations of PDI

Conformance testing in the field

- Connectathon tests potential of product
 - *NOT* performance of the item in the field
 - local implementation can change properties
- Need independent testing service, eg for CDs
 - ? How funded

Supporting the Profile :

College Guidelines

Inter-Collegiate Working Party

- **Guidelines for viewing HW, inc. Monitors**
- **Integrating CD into practice workflow**
- **Requirements for generic viewer**
- **Promote specification of IHE compliance**

In the Inbox...

- Newer portable media
(DVD, SD, USB...)
- Archiving : What
By whom
Where
For how long
- RANZCR “e-radiology” group

Conclusions

- Image transfer a major current issue in DI
 - fundamentally about interoperability
- Best addressed via the IHE process (& profile)
- IHE process has helped build consensus,
and has received referrer support
- Implementation in progress - non-trivial
- IHE Process applicable in many other areas
(workflow, eHR...)