DICOM
Media Management

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Outline

- Transport of images between sites
- Obstacles to the use of CD to replace film
- Media importation workflow issues
- Media creation workflow issues
- Higher capacity media - DVD
- Other media types - RAM-based media
Primary Use Case

• Images of patient made at source site
  – Hospital
  – Imaging center
  – Doctor’s office

• Need to be used by staff at Site B
  – Referring doctor who ordered exam
  – Doctor to whom patient has been referred
  – Specialist hospital (tertiary referral center)
  – Interventional facility
Three possibilities

• Film
  – Traditional, cost-effective, familiar
  – Undesirable if film-less source or destination

• Network between sites
  – Sufficient (affordable) bandwidth
  – Available communication infrastructure
  – Security infrastructure

• Interchange media
  – Carried by patient
  – Sent in advance of patient by courier
State of the Art: No PACS, all referrals using film
Ideal World: All PACS Connected, shared patient identifiers
An ugly compromise for PACS destination sites: digitize film
A realistic compromise: Standard Interchange Media
Modality -> Media -> PC Viewer or PACS Import
PACS -> Media -> PC Viewer or PACS Import
Is the Standalone PC Viewer a solution?
Standalone PC Viewer Issues

• CDs burned with Windows auto-run viewer
• Does everyone have a PC?
  – In the referring doctor’s examining room?
  – In the out-patient clinics?
• Hospital IT security policy?
  – Should IT allow any CD to be loaded on a PC?
  – Risk of viruses - how many clinic PCs virus-safe?
• Interference with running applications
  – Auto-run may need to be disabled
Standalone PC Viewer Issues

• Quality, training and ease of use for viewers
  – How many viewers does one need to learn?

• Long-term access requirements
  – Need images to become part of legal record
  – Follow-up visits
  – Use during treatment (RT, surgery, etc.)
  – Need for distributed access
    ➢ Internal referrals
    ➢ Clinical conferences
    ➢ Tumor boards
The best solution: Import standard media into the PACS
Barriers to PACS import: format, ID reconciliation, viruses
Barriers to PACS import: DICOM compliance issues
Issues with Import: Format

• General Purpose CD-R media profile
• Filesystem generally not a problem
  – Standard: ISO 9660 Level 1, but readers tolerant
• Image files are generally written properly
  – Rarely missing Part 10 meta information header
  – Rarely in wrong transfer syntax (e.g. not explicit)
• Filenames frequently illegal
  – Standard says 8 chars, capitals, no extension
  – Frequent errors - too long, with .dcm extension
Issues with Import: Format

- DICOMDIR errors especially prevalent
  - Long filenames -> illegal DICOMDIR entries
  - CS VR of file name components
    - 16 characters
    - no periods
  - Missing required attributes
    - E.g. Referenced Transfer Syntax UID
  - Violation of identifier attribute types
    - DICOMDIR requires Type 1 Patient ID, Type 2 in image
Issues with Import: Format

• Media creators (writers):
  – Should do better & comply with standard
  – Absolutely no excuse for poor quality software
  – Absolutely no legitimate reason for deliberate violations (such as file naming)

• Media importers (readers):
  – Should be more tolerant
  – Huge installed base of non-compliant creators
  – Few errors have any impact on data integrity
  – Most problems just annoyances to workaround
Barriers to PACS import: ID reconciliation & import workflow

1234 Smith^Mary
--->
9876 Mary Smith
ID Reconciliation & Workflow

• There is no universal patient identifier
  – Even in the US, SSN not used or not reliable
• Outside scheme almost always different
  – Another hospital uses own local ID scheme
  – Community imaging centers: no scheme at all
• No consistent patient naming
  – Conventions differ: “Smith^Mary”, ”Mary Smith”
  – Typographic errors: “Smith^Mry”
• Other identifiers, like DOB, may be absent
ID Reconciliation & Workflow

• Why are IDs so important?

• Without proper ID, imported images “lost”
  – Can’t expect doctor to hunt through all possible
  – Failure of subsequent scheduling, routing, billing

• Can’t allow foreign IDs into system
  – Naïve import would use whatever present on CD
  – Potential for conflict with real local IDs
ID Reconciliation & Workflow

• Simple header editing
  – Manually edit DICOM ID attributes
  – Poor usability, risk of error, better than nothing

• Route into “lost” or “problem” pool
  – Poor workflow
  – Different staff responsible for reconciling

• Specific “Media Importation Workflow”
  – Manual, semi-automated or automated reconciliation
  – Scheduling of import (with an order and a work list)
  – Assignment to destination (clinic, physician, etc.)
Barriers to PACS import: Risk of exposure to viruses
Risk of Exposure to Viruses

• Windows PCs in PACS create risk
  – Most common target for viruses
  – Viruses can spread on media, though nowadays more common on network or via email
  – Auto-run executables would be greatest threat

• Impractical to depend on source sites
  – No control over where media comes from
  – Pre-qualifying sites impractical
Risk of Exposure to Viruses

• Extreme solution: forbid media importation
• Use non-Windows platform for import station
• Isolate import station
  – Router should prevent anything except DICOM traffic
  – Prevent file sharing, tftp, smtp, web access, etc.
• Restrict permissions of import station user
  – No executable installation, etc.
• Disable auto-run capability (registry setting)
• Disable exploring media (application interface only)
• Automatic, frequent virus scanning with updates
Risk of Exposure to Viruses

- Same risk exists on physician’s desktop
- Hence forbidding PACS import in favor of using PCs in the clinic makes little sense
- Admittedly, IT may have greater control over their “own” PCs, as opposed to those in a vendor’s turn-key PACS
Media Import Summary

• Creators must do much better
  – They have no legitimate excuse
  – Simply poor quality

• PACS must support dedicated import feature
  – Must tolerate non-compliant media
  – Workflow that supports import
  – Perform identifier reconciliation and coercion

• Not something the DICOM standard can fix

• Perhaps an IHE profile is needed?
So what is DICOM doing?
Media Creation Management

• Use-case is “print to media” from workstation
• Images transferred normally
• New service handles
  – Request (what images, what profile, label, etc)
  – Status
• Media creating device (SCP)
  – Compresses images (if necessary)
  – Builds DICOMDIR
  – Burns media
Higher Capacity Media

• Not for archive but for interchange
• Large studies won’t fit on CD
• DVD additions (Supplement 80, June 2003)
  – Anything a DVD-ROM drive can (should) read
  – DVD-R,-RW,+R,+RW
  – Mandatory compression support for readers
  – JPEG or JPEG 2000, lossless and lossy
RAM Media

• Use-case is primarily for transfer to PDAs
• Includes
  – Compact FLASH and similar
  – USB memory
• Not likely to be useful for inter-institutional interchange
  – Individual pieces of media are too expensive