DICOM in Cardiology

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GE Healthcare - Information Technologies
1992 Theme: Cine film replacement

• **Problem** – how to preserve diagnostic quality images without 35mm cine film, but with universal exchangeability

• **Solution** – leverage radiology’s DICOM standard, extend it to media interchange on CD
What’s the big deal?

• Cardiology talking to Radiology!
• DICOM (v.3) wasn’t even published yet!
• Workstations could not support data rate!
• Recordable data CDs didn’t exist!
• Needed a true international standard!
• Understanding images as data!
The Results

- DICOM Standard Supplements 1, 2, 3, 4 and 20
- DICOM WG1 – Cardiac and Vascular Information
  - International in scope
- Mission accomplished in only 4 years – universal acceptance of DICOM XA image exchange on CD-R
Opportunity – create a unified dataset with all of a patient’s cardiac exam data

Solution – incorporate ultrasound and nuclear DICOM images, extend DICOM for hemodynamic and electrophysiological waveforms, extend DICOM for cardiac measurements and reports, and get a bigger media
Results: Image Objects (easy)

- Basic Ultrasound and Nuclear images – done by WGs 12 and 3
- IVUS extension to Ultrasound done by WG1 – Supplement 48
- Still issues with NM interoperability
Results: DVD Media (relatively easy)

• DVD Media – Supplement 80 (2003)
  – STD-XA1K-DVD : XA up to $1024^2 \times 12$-bit
  – STD-GEN-DVD-JPEG : anything on DVD

• Readers required to support both JPEG lossless \textit{and} JPEG lossy
Results: Waveform Objects
(a bit harder)

- Waveform Interchange – Supplement 30
  - Hemodynamic
  - Electrophysiology
  - ECG (12-lead, general, ambulatory)
  - Basic Audio
- Used prior work of CEN SCP-ECG and HL7 v.2.3 Waveform Observation
- Adoption of DICOM waveforms has been disappointing
Measurements and Reports (hard)

- Based on DICOM Structured Reporting Supplements 23 and 53 (2000/2001)
  - IVUS Measurements – Sup 77 (2004)
  - CTA/MRA Measurements – Sup 97 (in process)
- All major vendors in process of implementing DICOM SR measurements
• **Demand** – Bring it all together to support the Electronic Health Record
  – *Support the delivery of effective patient care.*
  – *Facilitate management of chronic conditions.*
  – *Improve efficiency of clinicians and administration.*
  – *Improve patient safety.* [IOM, 2003]
• **Solution**
  – integrate with hospital information systems for consistent patient demographics
  – provide workflow management appropriate to cardiology
  – integrate results into patient record
  – link to non-hospital cardiology practice settings (crossing institutional boundaries)
  – consolidate data for longitudinal evaluation and on-going care
  – extract data for outcomes research and public health
  – support performance evaluation
IHE Cardiology

- Development in a new effort for *DICOM and beyond*: Integrating the Healthcare Environment - Cardiology
- Integration Profiles – tie together all the pieces into a consistent workflow solving the real-world user’s problems
- Process to encourage and facilitate implementation of standards-based interoperability
- Sponsored by American College of Cardiology with European Society of Cardiology
- Leverage prior five years of IHE Radiology and one year of IHE IT Infrastructure
IHE Cardiology Year 1 Profiles

• Cath Lab Workflow
  – Multimodality synchronization
  – Handle unscheduled exams / unknown patients

• Echocardiography Workflow
  – Support intermittently connected modalities
  – Consistent stress data labeling

• Retrieve ECGs for Display
  – PDF-based
  – Ubiquitous Web access
IHE Cardiology Year 2 Profiles

- Evidence Creation
  - DICOM SR measurements
  - Cath Procedure Log
- Report Creation
  - PDF-based reporting
- Report Distribution
  - Retrieve Information for Display (RID)
  - Cross-enterprise Document Sharing (XDS)

Echocardiography Measurement
Patient: Doe, John  Technologist: der Payd, N
Measurements:
Mitral valve diameter 3.1 cm
- shown in image at [ ]
Ventricular length, diastolic 5.97 cm
- shown in image at [ ]
Ventricular volume, diastolic 14.1 ml
- inferred from [ ]
- inferred from VLZ algorithm
IHE Cardiology Year 3 Profiles (tentative)

- **Stress Testing Workflow**
  - Combined stress ECG with stress imaging
- **Portable Integrated Cardiac Record**
  - Everything on recordable DVD
- **Electrophysiology**
  - Ablation/implant lab
- **All involve both DICOM and HL7**
DICOM Features used by IHE Cardiology

- **Images**
  - XA, US, NM, CT, MR
- **Structured Reports**
  - Echo, QCA, QVA, IVUS, Hemo, ProcLog
- **Waveforms**
  - Hemo, EPS, ECG (as imaging adjunct)
- **Encapsulated PDF**
- **Transfer Syntaxes**
  - Default, Lossless JPEG, Lossy JPEG
- **Workflow**
  - MWL, MPPS, Storage Commitment
  - Query / Retrieve
- **Media**
  - CD, DVD
DICOM + Cardiology = Synergy!