The Proposed Northwestern Collaboration with NA-MIC

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Department of Radiology
Who are we?
3 separate (non-profit) entities

• Northwestern University
  – Feinberg School of Medicine
    • Department of Radiology
• Northwestern Medical Faculty Foundation
  – Multi-specialty physician practice
    • 500 physicians, 1000 healthcare professionals
• Northwestern Memorial Hospital
  – 700 bed facility
Department of Radiology

- 60 radiologists (46 FTE)
- 28 radiology residents
- 285 Staff
- 400,000 radiology procedures per year
- Large research operation
  - MR
    - Neuro and Functional MRI
  - Cardiac CT and MR
  - (Digital) Mammography
  - Informatics
    - Largest GE PACS R&D partner 1999-2004
Clinical Environment

• 70 modalities from 11 vendors
• Large GE PACS
  – 1.9 million studies
    • 145 million images
  – 30 diagnostic workstations; 70 other workstations
  – Ubiquitous web access
• Large Cerner RIS
• 100% human dictation and transcription
  – Homegrown Lucene index of 2M reports
Continuous pressure to increase volume, accuracy and efficiency of these tasks
Radiology (after D. Enzmann)

Happy, Healthy, Well served

Patient

Physician

Scheduling

Ordering

Reporting

Confident, Expedited

Peer Reviewed Research Funding
Industry Collaboration

Radiology Research

Basic Research
Applied Research

Operations

Scheduled Workflow

Post-Processing Workflow

Expert, Efficient

Technical Billing

Residency

Medical School

RT School

MBA School

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New Acquisition Techniques and Technologies

New Post Processing Techniques

Image Based Clinical Trials

Wet Science

Validation

New Knowledge to us

New Knowledge to others

“The Hospital”

“The Lab”

FDA

MQSA

“Organification”

Scheduled Workflow

Post-Processing Workflow

Reporting Workflow

Patient

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H I P A A

I R B

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“The Lab”

HIPAA

IRB

FDA

MQSA

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Trouble in Paradise (I)

• Clinical Workstations
  - Commercial workstations typically cannot be “evolved” by the end users
  - GE has not innovated the PACS workstation in several years
  - GE Advantage Windows, other specialty workstations, and PACS workstation pathways not converging (fast enough?)
  - GE is investing in other areas (EMR, etc.)
  - Market driven engineering does not work
    • Vendors (including GE) focus on sales requirements of early and late majority
      - The latter have not reached impasses that early adopters have already reached and will never ask for things that they have yet to imagine
Trouble in Paradise (II)

• Research (Workstations)
  - Imaging research performed in the lab on MatLab, IDL, (and vtk and itk?!)
    • Trapped forever in the lab?
  - Difficult to find, de-identify and work with large number of clinical studies
  - Difficult for clinical radiologist to find time to collaborate with their basic science peers
Our little Nirvana

• Build a (open source) workstation that meets the needs of both the clinical and research medical imaging communities

• Leverage off of existing NA-MIC / Slicer strengths in the research space

• Have a clinical / research mode switch
  – Warn of experimental use in research mode
  – De-identify in research mode
## Requirements

<table>
<thead>
<tr>
<th>Clinical</th>
<th>Research</th>
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</thead>
<tbody>
<tr>
<td>• IHE Reporting Workflow</td>
<td>• Advanced apps</td>
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<tr>
<td>• Hanging protocols</td>
<td>• Advanced Vis</td>
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<tr>
<td>• Bread and Butter Vis.</td>
<td>• Advanced Registration</td>
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<tr>
<td>• Bread and Butter Regis.</td>
<td>• Advanced Segmentation</td>
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<tr>
<td>• Annotation and Markup</td>
<td>• LONI pipeline</td>
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<tr>
<td>• Reporting</td>
<td>Both</td>
</tr>
<tr>
<td>• QA/QC</td>
<td>• DICOM WG23</td>
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<td>• FDA</td>
<td>• Feedback to developers</td>
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<td>• Rapid release cycle</td>
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What is IHE?

IHE

Integrating the Healthcare Enterprise™

“A process that drives the use of existing standards to solve complex healthcare information processes that span multiple, heterogeneous information systems.”
Healthcare Site with Complex Problematic Process involving heterogeneous information system

Vendor expertise

Integration Profile

Proposed solution Using existing standards

IHE Technical Framework details solution

Vendor implements solution into REAL product

Vendor tests solution at Connect-a-thon

Professional Societies Demonstrate/Educate That solution exists

Healthcare Site Includes IHE in RFP
Commonalities

• Make a worklist
• Query for the worklist
• Claim a workitem
• Tell when you start
• Tell when you finish
• Store (and commit) your results
• Tell what you did
• Automatic handoffs – no fumbles
Reporting

- **IHE Reporting Workflow SETS YOU FREE**
  - *Exposes worklist driven workflow*
- **5 ways to report:** N, SR, MadLibs, VR, HT, SYB
- **DICOM S/R provides the object architecture**
  - Integrate “evidence documents” such as CAD and measurements
- **Must be able to deliver HL7 v2 ASCII rendition**
- Need to freely convert to/from HL7 CDA (xml)
- Need standard lexicons (BIRADS, RadLex)
- Need library of standard radiology report templates (CDA)
- Need “advanced” communication options
IHE Teaching File and Clinical Trial Export

DSS OF

Image manager Image Archive

Export Manager

Export Receiver

MIRC Field Center

Export Receiver

MIRC Teaching File Authoring tools

Export Receiver

3rd Party Teaching File

WORKSTATION

Image Display

Report Creator

Report Reader

Export Requestor

MODALITY

Report Reader

Export Requestor

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TRIP™

Transforming the Radiologic Interpretation Process

Improve the **QUALITY** and **QUANTITY** of work performed by radiologist in digital environment
Other interesting things

- Change the way radiologists work; reduce variance
- Affects all of CREAM
- Improve delivery of radiologist value add to referring physician
- Software instrumented to document and feedback $\Delta$ in Q and Q to radiologist
- UI
- Navigation
- Auditing / Logging

Integration of all modalities
- Image
- 2D, 3D postprocessing
- CAD
- Sound, sonification, audification

- Work management
- Time management
- Interruption management
- Communication management
Hanging Protocols

• Must be DICOM Part 60 compliant
• Must support all (17?!) DICOM Image Objects
• Must be very robust
• Must be configurable based on procedure code, etc., etc.
Bread and Butter Vis, Reg, Seg

• 3D MIP, MPR, surface render, etc. built into routine viewing (of appropriate data sets)
• Simultaneous rendering of single frame of reference stack
• Facile routine operations
• IHE Image Fusion
  • Deformable Spatial Registration Object
    - DICOM Supplement 112
  • Color Softcopy Presentation State Object
    - DICOM Supplement 100
Annotation and Markup

• caBIG Imaging Workspace developing SIAM
  – Standard for Image Annotation and Markup
  – DICOM S/R versus/compatible with XML and Grid Services
  – Semantic interoperability of annotations

• DICOM Key Image Notes for clinical use
QA / QC

• Technical quality of images
  – Feedback to technical staff
• Report discrepancies
  – Peer review
DICOM WG 23: Application Hosting

• “Plug-ins” for clinical diagnostic workstations
What does NA-MIC Northwestern look like?

- JAVA Dcm4Che Server
- XML DB
- Image Store
- JAVA Dcm4Che Server
- HL7 Services
- mySQL

- VTK
- iTK
- LONI
- Slicer 3
- C# Client

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Why?

Diagram showing the integration of various technologies and services such as VTK, iTK, LONI, Slicer 3, C# Client, DICOM Services, HL7 Services, JAVA Dcm4Che Server, Image Store, XML DB, and mySQL.
A “Translation Station” for Radiology

- Clinical efficiency for the radiologist
- Development platform for radiology research
- Evaluation and validation of new functionality
- Facile collaboration between clinicians and researchers
- Rapid iteration cycle
Next Steps

• Northwestern team to attend Project Week with intent to understand Slicer 3 architecture and integration points.

• Awaiting funding decision on collaboration from NIH