Imaging in the Enterprise
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DISCLAIMER: The views and opinions expressed in this presentation are those of the author and do not necessarily represent official policy or position of HIMSS.
Conflict of Interest

Richard L. Kennedy, MSc, CIIP

Has no real or apparent conflicts of interest to report.
Learning Objectives

Learning Objective 1: Describe critical components of a successful Enterprise Imaging strategy.

Learning Objective 2: Develop an information governance model for executing an enterprise imaging strategy that is part of a larger EMR strategy.

Learning Objective 3: Understand how image workflow differs among medical specialties.

Learning Objective 4: Describe types and location of enterprise image storage in use today.
How did we get here?

- WAYBAC Machine
- Evolution—from:
  - “Films in Radiology”
  To
  - “Any Image Anywhere”
  To
  - “EMR integrated imaging”
“Enterprise Imaging in 1990”
WAYBAC Machine

• The Radiologist often took days or weeks to interpret the images
• If this was too long, (often!) the “Enterprise” came to Radiology and talked to a Radiologist there…
• The “Enterprise” might ask to “borrow” the films for a bit
• Sometimes the “Enterprise” wasn’t all that good at returning them, though…[lost films]
• But note the communication and collaborative processes in this
PACS Revolution

• The transition to digital imaging and PACS (Picture Archiving and Communications Systems) has fundamentally and permanently changed the relationship of Radiology and the Enterprise.

• Films became data, data was portable and replicable, and could be transmitted and propagated at will. Films belonged to Radiology. Data belongs to the Enterprise. Image data became integrated to the EMR.

• This all drove enormous practice change in Radiology as well as technology change.

• “Enterprise Image Distribution for Radiology is about much more than the pixels!”
Evolution from Film to Enterprise

- PACS 0.0
  - Film
- PACS 1.0
  - Primitive, expensive, and did not eliminate film
  - Technology not yet ready (compute, display, storage)
  - Provided development framework of critical standards—DICOM
- PACS 2.0
  - Enterprise distribution feasible (technology began to catch up)
  - Web access to PACS and images (EMR integration)
  - Development of structured reporting
- PACS 3.0
  - Fully EMR distributed
  - Ubiquitous (multi-platform, mobile)
  - Advanced structured reporting the norm
  - “Real-time reading”
  - Advanced communication/collaboration capability through EMR
  - Enterprise Archival (VNA)
PACS 1.0

- Still Radiology Centric
- “Electronic Alternator” model
- Expensive (!!!) and still no Enterprise Distribution,
  So we still printed film…
PACS 1.0

- Archival was cumbersome
- Technology was not yet available for online storage in required volumes for PACS
- Generally “boutique” systems
PACS 2.0
Any Image, Any Where

• As PC memory and storage technology evolved to be able to effectively support PACS viewing on general purpose computing platforms, rather than just “exotic” specialty platforms, Enterprise distribution of medical images became technically feasible.

• In parallel, storage technology evolved to support practical spinning online storage of clinically required data.

• Enterprise Image Distribution started to be become feasible and achievable.
PACS 2.0
Any Image, Any Where

- Enterprise Distribution
  - Desktop PC capabilities evolved to support effective image viewing throughout the enterprise
  - Previously, dedicated and expensive “viewing stations” were required for PACS access. This was a foundational technology change to enable enterprise imaging.
  - GPUs became common
PACS 2.0
Any Image, Any Where

• Still largely Radiology and Cardiology centric, but other image content from other departments began to develop as PACS models—OR, GI, OR Endoscopy, Dermatology, Ophthalmology, etc.
  – The rise of the “ologies” model
• Web services from PACS enabled EMR integration, and fundamentally and permanently changed the enterprise image distribution paradigm. (“PACS content as web services”)
PACS 2.0
Any Image, Any Where

• EMR integration
  – Web Accessible PACS enabled “reusable” integration(s) to EMR, and these are now the standard of practice for Enterprise image distribution from the EMR.

Sample Usage

http://<IP Address>/<directory>/EMR.aspx?acc=<Accession>&mrn=<MRN>&mnem=<EMRUserName>&timestamp=<timestamp>
PACS 2.0

Any Image, Anywhere

Image Delivery vs Report Delivery

• Images now in Seconds, but Reports still in Days
  – Created a practice disconnect!
• This, in turn, drove major changes to Reporting (and RIS)
  – TAT standards of practice change (days to hours)
  – Speech Recognition (to eliminate Transcription delays)
  – Structured Reporting/Templates start to develop
  – Structured Content (DICOM SR-Modality, Measurements, etc.)
  – Lexicons start to develop (Bi-RADS)
PACS 2.0
Any Image, Any Where
--Changes in Radiology Practice

• Turnaround Times from Days to Hours (or less)
• EMR integration of images and reports and enterprise communication and collaboration enabled through the EMR
• “PACS/RIS-centric” to “EMR integrated”
• Text Report to Structured Report to EMR Integrated Content
PACS 3.0 (In the Enterprise)
Where are we headed?

- Enterprise Centric
- EMR as primary integration point and platform for Enterprise Image Access
- “Ecology of Enterprise image content” rather than “Rad + Card + ’ologies ”
PACS 3.0 (In the Enterprise)
Where are we headed?

- Evolution of Enterprise archival—”Vendor Neutral Archive” (VNA)
- Universal Enterprise Viewer (EUV)
- Zero Footprint Viewer (ZFV), typically now via HTML5
- Mobility (tablets, smartphones and beyond)
PACS 3.0
Where are we headed?

• Vendor Neutral Archive--VNA
  – (A somewhat ambiguous term, unfortunately, but now accepted)
  – Generally used to describe archival image storage, typically of DICOM content, maintained separately and externally to the PACS itself.
  – Since PACS (Picture Archiving and Communications Systems) generally instantiate an archive internally, VNA represents something of a change to traditional PACS architecture. (Not all PACS accept this well…)
  – Generally also shared by other imaging departments/sources, enterprise VNA deployment may require additional aspects of governance than standalone/departmental PACS.
  – However, potential benefits include
    • Economies of scale/support
    • Support for PACS vendor migration
    • Support for Image Lifecycle Management at enterprise level
PACS 3.0 (In the Enterprise)  
Where are we headed?

• Enterprise Universal Viewer -- EUV
  – Need to be careful to retain collaboration and communication
  – Need to be careful to still support specialty tools
    • Spine annotation, Cobb angle, Hounsfield units, etc. etc.
PACS 3.0 (In the Enterprise) Where are we headed?

- Zero Footprint Viewer – ZFV
  - Typically now HTML 5
PACS 3.0 (In the Enterprise) Where are we headed?

- Potential VNA and EUV issues to avoid
  - Loss of synchronization between PACS and VNA for metacontent
    - Annotations
    - Presentation States
  - Loss of **collaboration and communication** capabilities
  - Let’s not have to revert to 1990 and phone calls!
Mobility (tablets, smartphones and beyond)

- Capabilities of tablets, etc. now support full resolution imaging capabilities
- Mobile use cases—ED, Hospitalists, etc.
- “Smartphone consults” (“Bonephone”)
PACS 3.0 Changes in Rad Practice
Where are we headed?

- Report Turnaround Times from Hours to Minutes (“Realtime”)
- Evolution from “Toss the Report over the Wall” to EMR integration and enterprise collaboration and communication enabled through the EMR
- “PACS/RIS-centric” to “EMR-centric”
- Text Report to Structured Report to EMR Integrated Multimedia Content
  - “Note in in this image” with link integration
  - Increased emphasis of “digestion” of large/complex imagesets by Rads
PACS 3.x
Where are we headed?

• (Re)Structure of Radiology Reporting model
  – Evolution from “free text” (“Dictated by:”) narrative reporting to template driven reports and linking of reports to/from images (enterprise communication via IHE profiles:
  – IHE profiles relevant to this:
    • Key Image Notes (KIN)
    • Simple Image and Numeric Report (SINR)
    • Evidence Documents (ED)

http://www.ihe.net/
PACS 3.0
Where are we headed?

• Structured content, more and more of this (DICOM SR, ED, SINR)
  – Radiation Dose (California SB1237 now CMS)
  – Contrast Dose from injectors
  – Protocol data from scanner

Diagnostic report text

CT ABDOMEN AND PELVIS WITH IV CONTRAST

** HISTORY **:
Abdominal pain. Rule out appendicitis and diverticulitis

** FINDINGS **:
Technique: CT of the abdomen and pelvis performed following the administration of 110 cc Omnipaque 300 IV contrast. 5 mm axial images with 3 mm coronal and sagittal reformations are available for review.

CTDI: 7.89 mGy
DLP: 360.18 mGy·cm
PACS 3.0
Where are we headed?

• Structured content (ED, SINR)
  – OB, Vascular, etc. measurements from Technologist at scanner
Findings:

BPD
...
.....

Image Refs.:

IHE Interoperability Workshop
Sanjay Jain

Sept 13-15, 2004
Can You Make A Report Like This?

Institution Identification
Patient Identification
Study Identification
    Technique Identification

Discussion

The liver is normal. There is a focal area of decreased attenuation adjacent to the falciform ligt., likely representing focal fat (<Key Image link>). The spleen, both kidneys, the … are normal.

Impression

CT of the abdomen within normal limits

Signature

Sept 13-15, 2004
PACS 3.x
Where are we headed?

- More and **more** Structured Content
  - Modality Protocols via SR
  - CAD integration, new CAD use cases (LDCT-LS, etc.)
  - More yet to come
- More and more advanced Structured Reporting
  - RSNA RadLex
  - [http://www.rsna.org/radlex](http://www.rsna.org/radlex)
- Lexicon and template driven structured reporting → **Data Analysis**
  - Reports: “Free text” to “extractable **data**”
PACS 3.x
Where are we headed?

STATUS
RadLex Playbook 2.0 (Nov. 2014)
Playbook 2.0 represents a carefully curated set of RadLex Playbook exams, covering the full range of clinical imaging modalities, including radiography, angiography, fluoroscopy, mammography, CT, US, MR, nuclear medicine, as well as hybrid modalities and image-guided procedures. While not intended to be exhaustive, this set represents the full list of radiology “orderables” at a large academic medical center. As such, it is offered as a starting point for Playbook adoption, and an illustration of how Playbook attributes are used to specify imaging exams. Playbook 2.0 consists of 1,113 exams, including 146 radiography exams, 114 CT exams, 166 MR exams and 111 US exams.

Each Playbook entry includes:
- A unique identifier (RPID) used in information systems to identify the Playbook name.
- A letter code, which can be used in DICOM header information
- A short description and a long description
- Mappings to RadLex terms that provide components of the Playbook name, such as modality, body part, indications, etc. These mappings are useful in query and data analysis applications.

<table>
<thead>
<tr>
<th>RPID</th>
<th>Letter Code</th>
<th>Short Description</th>
<th>Long Description</th>
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<tr>
<td>RPID2</td>
<td>CTABCA</td>
<td>CT Abd Angio w/wo</td>
<td>CT Abdomen Angio w and wo IV Contrast</td>
</tr>
<tr>
<td>RPID3</td>
<td>CTABU</td>
<td>CT Abd wo</td>
<td>CT Abdomen wo IV Contrast</td>
</tr>
<tr>
<td>RPID4</td>
<td>CTABC</td>
<td>CT Abd w/wo</td>
<td>CT Abdomen w and wo IV Contrast</td>
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</table>

http://www.rsna.org/RadLex_Playbook.aspx
PACS 3.x
Where are we headed?

• More EMR driven collaboration with PACS, in Real-Time
  – Collaboration/communication tools embedded in PACS workflow
    • “Hey Bob. What about this ankle?”
    • “Note mass in this image <key image link>”
• More interaction with the Enterprise via EMR, and more value-add
  – “Mushroom (“Live in the Dark” Radiology” →
    “Part of the Extended and Connected Care Team”
• Radiology product is more than “Pictures”—Enterprise Image Distribution must include the entire product: Images, Reports, Consultation, etc.
PACS 3.x
Where are we headed?
Summary

• Radiology **product** is more than just the **pixels**
• **Enterprise Image Distribution for Radiology** must support:
  – Full integration of reports and images
  – Full and seamless integration of PACS/RIS/EMR
    • (Even in some cases, the EMR **becoming** the RIS)
  – Report context structured and consumable as **data**
  – Annotations (KIN) linked to report, and reports linked to images
  – Facilitate better provider/radiologist communication
Questions

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Dawn of the Era of Enterprise Imaging
April 14, 2015
Louis Lannum
Conflict of Interest

Louis Lannum

Lannum & Associates, LLC
Learning Objectives

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Description

This session developed under the auspices of the HIMSS/SIIM Workgroup on Enterprise Imaging will present use case scenarios from organizations that have successfully executed enterprise imaging strategies as well as excelled at determining new workflows and technologies to support the best use of medical images throughout the enterprise.
Enterprise Image Management

Developing an enterprise standard for the management of all clinical imaging
Strategy

We realized that there were significant pieces of clinical data missing in the EMR.

Developed a program to **capture, index, manage** and **store** the missing data.

Provide access by making this missing data available in the EMR.
Enterprise Imaging Strategic Plan

Managing images from outside the system and providing access through the EMR.

Central archive model
Department workflow management
Managing imaging meta data
Centralized image management
Single point of image access

Governance
Governance

Effective and engaged governance is key to a successful enterprise imaging strategy

- Provide oversight and direction
- Ensure strategic and program goals are achieved
- Coordinate the program across the health system
- Communicate the strategic initiative
- Create a forum for collaboration between departments

Imaging Council

Do not confuse project management with governance!
Information Governance

How we index imaging information is important

- Strategies for the organization of images in the EMR
- Metadata standards
- Order naming conventions
- Coordinating the display of images with reports / clinical findings
Service-line Integration

Imaging Across the Enterprise
Service-Line Integration

Traditional Imaging – Radiology and Cardiology

Department level – 3rd Party systems

Surgical and Procedural Scope Imaging

Standalone – Image Capture Devices

Point-of-Care Ultrasound

Digital Photography

Mobile Health Strategy (turning the mobile device into an acquisition device)
### Workflow Model

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<th>Study Ordering - Scheduling</th>
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<td>Image Sharing - External</td>
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**Capture (Acquisition)**

What Radiology has done well over the years is to develop DICOM standards that allow the different modalities from different vendors to send images to the PACS.

Managing the image starts with an integration with the EMR with either a department image management system or an enterprise workflow engine.

**Image Accessibility**

- Diagnostic
- Clinical Reference
- EMR Integration
- Mobile
- Portals
Questions?

Louis Lannum, Director Enterprise Imaging

Cleveland Clinic