

Extending DICOM to integrated information environments: IHE

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Disclosure

- **Receive royalties from SPIE for a book I co-edited**
- **Member of an advisory board for Stentor**
- **Have consulted for: Memorial Hospital, Hollywood, FL, and Delnor Hospital, Geneva, IL**

Introduction

- **DICOM and imaging**
- **Replacing film with PACS**
- **What is wrong with the scenario?**
- **Going beyond DICOM**
- **IHE impact: workflow problems**

Introduction

- **The IHE Profiles: examples**
- **How IHE grows**
- **What is on the IHE horizon**
- **Conclusion**

DICOM and imaging

- **DICOM has had a 20-year history of providing interface specifications for imaging equipment**
- **DICOM is one of the most successful standards in medical imaging**

Replacing film with PACS

- **The idea of early PACS implementers:**
 - **Made practical with low-cost computers, displays, and storage**
 - **The challenge was engineering: how to get needed performance with available hardware**

Replacing film with PACS: what is wrong with this scenario?

- **Analysis of the “old way”**
- **What happens if we “plug-in” PACS to replace the film-based functions?**

Replacing film with PACS: what do you gain?

- Eliminate (or nearly so) purchasing film and processing chemistry
- Remove most film processors
- Eliminate waste water problem
- Reduce film library personnel requirements
- Images are available in multiple locations

Replacing film with PACS: what do you gain:

- Reliable, fast archive
- Improved workflow?
 - Let's look at this more closely
 - What actually happens in a radiology department or practice?

The "old way" film and paper (but with information systems)

- Analysis shows a LARGE number of manual steps and interactions with different systems
 - In our study, 32 steps (with a RIS, HIS, and PACS but not integrated)
 - In Dr. Siegel's study, 59 steps (assuming no RIS or PACS)

The "old way" film and paper (but with information systems)

- Each step is a potential delay point and any manual data entry operation is a potential error source
 - As a side study of research we did, technologist data entry can have error rates as high as 20%

What is wrong with this scenario?

- The whole process typically takes from 1-3 days
- Emergency requests require effort on the part of the requesting physician

What is wrong with this scenario?

- There are multiple points of potential error or failure (e.g., patient is transferred; the report is printed on the wrong floor)
- The process imposes workload on personnel

What happens if we simply replace film with PACS?

- Do we improve workflow?
- What have we done to solve the problems that film creates?
- What new problems have we made for ourselves?

Examples of workflow impact

- Study of x-ray technologist tasks pre- and post PACS
- Study of ultrasound sonographer task times

X-Ray technologist task comparisons

- Our studies have shown an approximate 50% increase in technologist time (general radiography) AFTER PACS implementation

X-Ray technologist task comparisons

- Reasons for increased time:
 - Increased interaction with information systems
 - Very lengthy process for correcting mistakes
 - Queues for QA workstations (we created this problem)

Study of ultrasound sonographer task times

- Sonographers spend approximately 5 minutes (median time) interacting with the RIS and entering patient data for each patient
- For a 20,000 patient per year section, that 5 minutes per sonographer is equal to 69 person DAYS per year!

Why doesn't DICOM solve these problems?

- DICOM primarily addresses the communication of images and associated information between imaging equipment and other devices

Why doesn't DICOM solve these problems?

- DICOM does not address what happens in other health information systems that affects PACS and *vice versa*

Enter IHE: Integrating the Healthcare Enterprise

- 1997 – 1999: the Radiological Society of North America (RSNA) and the Healthcare Information and Management Systems Society (HIMSS) decide to collaborate

IHE

- The scope is to address the clinical scenarios underlying the interaction of PACS with other information systems (IS)
- DICOM is the standard widely used by PACS vendors
- HL7 is the ubiquitous healthcare IS standard

What does IHE do?

- Develops the clinical scenarios and information models to support them
- Determines the features of DICOM and HL7 needed to support the information models
- The resulting profiles are demonstrated at RSNA and HIMSS meetings

What *doesn't* IHE do?

- IHE is NOT a standards developing organization;
- It fully makes use of the DICOM and HL7 standards, but does not (in itself) extend or modify those standards

How can IHE help solve these problems?

- When we re-examine our ultrasound ordering scenario but this time assuming the IHE Scheduled Workflow Profile has been implemented:
 - Step count is reduced to 9
 - Technologist workflow bottlenecks are eliminated

IHE Scheduled Workflow

- A major foundation for the IHE Profiles
- Supports the transactions and communications between HIS, RIS, and PACS
- Uses existing standards

Impact of Scheduled Workflow

- When we implemented just part of Scheduled Workflow, the 50% increase in technologist time became a *reduction* in technologist time (about 15%) compared to film

Scenario two: “Crash in the ER”

- An unconscious patient is brought into the ER
- The patient clearly needs multiple studies
- Scenario two: “Crash in the ER”
- So, how do the imaging studies (and laboratory studies) get done if the patient’s name and any record number he has are unknown?
- In the past, we did these with “trauma patient” as a name and a sequential, nonrepeating ID

Scenario two: “Crash in the ER”

- The problem is not doing the studies, but how to reconcile them afterwards once the patient’s name IS known.
- Otherwise, the studies may be “invisible” to the rest of the record.

How does the IHE help this situation?

- **The Patient Information Reconciliation Profile is designed to fix exactly this problem.**
- **Interactions between the PACS, HIS, and RIS allow for after-the-fact record matching and updating.**

Scenario three: “My monitors all look different!”

- **With film, the same image was seen by the radiologist and other physicians**
- **With workstations, image display is distributed and is heavily influenced by the local monitor setup**

Scenario three: “My monitors all look different!”

- **The DICOM Grayscale Display Function Standard was developed to address this problem**
- **The IHE Consistent Presentation of Images Profile expands on this and also adds DICOM Presentation State Storage**

IHE and consistent displays

- **The DICOM Presentation State Storage Service Class allows for storage of information about how the image was displayed and viewed along with the image**
- **The goal: have consistent image displays throughout an enterprise**

Scenario four: “You sent me an MRI with a thousand images!”

- **With a large number of images in an examination; which are relevant to the clinical problem?**
- **Many physicians use the images to consult with the patients; which ones should they show?**

IHE and key images

- **The IHE Key Image Note Profile supports the flagging of particular images in an examination as significant**
- **A note may be linked to these images**
 - **Explaining a finding**
 - **Posing a question to a consultant**

Scenario five: “We scanned the patient head-to-pelvis; who will read these?”

- **A “single” CT study (from the head through the pelvis) is to be read by three different radiologists (neuroradiology, chest, abdominal imaging)**
- **We can’t ask technologists to start and end three separate examinations!**

IHE and Presentation of Grouped Procedures

- **The IHE Presentation of Grouped Procedures Profile addresses this clinical problem**
- **It allows a single examination to be broken up virtually into component examinations**

Scenario six: “Why do I have to access PACS for images and the RIS for reports?”

- **Though many PACS support reports along with examinations, there is no link between the reports and the images**
- **If the radiologist does not provide a reference, it is left to the referring physician to link them**

IHE and reports

- **The IHE Simple Image and Numeric Report Profile is designed to be a first step towards integrated, structured reports**

Scenario seven: “Why can’t I get radiology information from all our systems?”

- **Referring physicians have to interact with multiple systems**
- **Radiology (like laboratory systems) is ubiquitous in healthcare**
- **Why should the physician have to access separate systems?**

IHE and access to radiology information

- **The IHE Access to Radiology Information Profile supports a number of query transactions designed to allow disparate systems to access radiology images and reports in a consistent manner**

Scenario eight: “We did the study, how do we get paid for it?”

- **Sometimes part of an HIS, more often another IS is a billing system**
- **Detailed information about the examination is in the PACS and RIS**

IHE and Charge Posting

- **Makes the information that resides in PACS and RIS necessary for billing systems available to them**

Scenario nine: “How does IHE address HIPAA security?”

- **We are now required to provide security for medical records**
- **We have to restrict access to such records, yet provide the information when legitimately needed**

IHE and Basic Security

- **Provides the first level of a security infrastructure**
 - **Manages cross-node security**
 - **Provides for consolidation of audit trails**

Scenario ten: “How do I get workflow into CAD and 3D reconstruction?”

- **Increasing use of CAD systems and 3D and 4D workstations requires that they be able to employ the same workflow information that a PACS has**

IHE and Post-processing Workflow

- **This IHE profile extends the basic scheduled workflow profile to support the additional steps such as CAD and 3D reconstruction**

The value of IHE

- **We don't gain from PACS unless we can be more productive**
- **We need automation to be more productive**
- **The IHE Profiles provide tools to support the replacement of manual steps**

How the IHE effort grows

- **Domain-specific planning and technical committees (represent users and vendors)**
- **Partnerships with other US and international (Europe, Asia) standards and medical informatics groups**

How the IHE effort grows

- **Strategic Development Committee (formed in 2002)**
 - **Expand the IHE process to meet the integration needs of the entire healthcare enterprise**
 - **Engage experts from other key domains**
 - **Identify integration needs, possible barriers and problems, and potential solutions across domains**

What's on the IHE horizon?

- **IT Infrastructure Committee**
 - **Electronic master patient index**
 - **Query/Display**
 - **Synchronized patient views**
 - **Advanced security**
- **Primarily led by HIMSS**

What's on the IHE horizon?

- **Expansion into other domains, e.g.,**
 - **Cardiology**
 - **Laboratory**
 - **Pharmacy/medication management**
 - **Clinical engineering**

Where to find out more

- **www.rsna.org/ihe**
- **Start with the IHE Primer**
- **All of the current, and most historical, documents can be downloaded as PDFs**

Conclusion

- **IHE is bringing together manufacturers of different clinical information systems, much as DICOM did for imaging equipment**
- **The potential for IHE to improve productivity and reduce errors is very great**

Conclusion

- **Some aspects of IHE, already in operation, are having an impact on workflow now**

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