DICOM, HL7, RIS, PACS

A Rogue's Gallery of Acronyms

Or

An Intro to Imaging Informatics

SEAAPM Symposium April 2014

DICOM, HL7, RIS, PACS

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Learning Objectives

1) to understand the electronic flow of information throughout the radiology examination including systems both upstream and downstream which interact with the imaging modality.

2) to review the work of AAPM Task Group Number 248 – Interoperability Evaluation for Imaging Modality Acceptance Testing.

High Altitude

My Level

My Level

Who's On First?

Radiology Technologists

Radiologic technologists are the medical personnel who perform diagnostic imaging examinations and administer radiation therapy treatments.

Radiologic technologists who perform imaging examinations are responsible for accurately positioning patients and ensuring that a *quality* diagnostic image is produced.

Radiology Technologists

Quality Management Technologists

use standardized data collection methods, information analysis tools and data analysis methods to monitor the *quality of processes and systems* in the radiology department. They perform processor quality control tests, assess film density, monitor timer accuracy and reproducibility and *identify and solve problems associated with the production of medical images*.

Source: http://www.asrt.org

Imaging Informatics

"Medical imaging informatics is
a multidisciplinary field that intersects with the biological sciences, health services, information sciences, medical physics, and engineering.

Imaging Informatics

Imaging informatics *touches every aspect of the imaging chain* from image creation and acquisition, to image distribution and management, to image storage and retrieval, to image processing, analysis and understanding, to image visualization and data navigation; to image interpretation, reporting, and communications. The field serves as the integrative catalyst for these processes and forms a bridge with imaging and other medical disciplines.

Imaging Informatics

Imaging informatics professionals and scientists specializing in this evolving field are pioneers involved at the intersection of information science, imaging technology and healthcare and require clinical acumen as well as expert understanding of technology."

Katherine P. Andriole, PhD, FSIIM

Source: http://siim.org

Healthcare IT

Health informatics (also called health information systems, health care informatics, healthcare informatics, medical informatics, nursing informatics, clinical informatics, or biomedical informatics) is a discipline at the intersection of information science, computer science, and health care. It deals with the resources, devices, and methods required to *optimize the acquisition, storage, retrieval, and use of information* in health and biomedicine.

Source: http://www.Wikipedia.org

Medical Physicists

What do Medical Physicists Do?

Medical physicists are concerned with three areas of activity: clinical service and consultation, research and development, and teaching. On the average their time is distributed equally among these three areas.

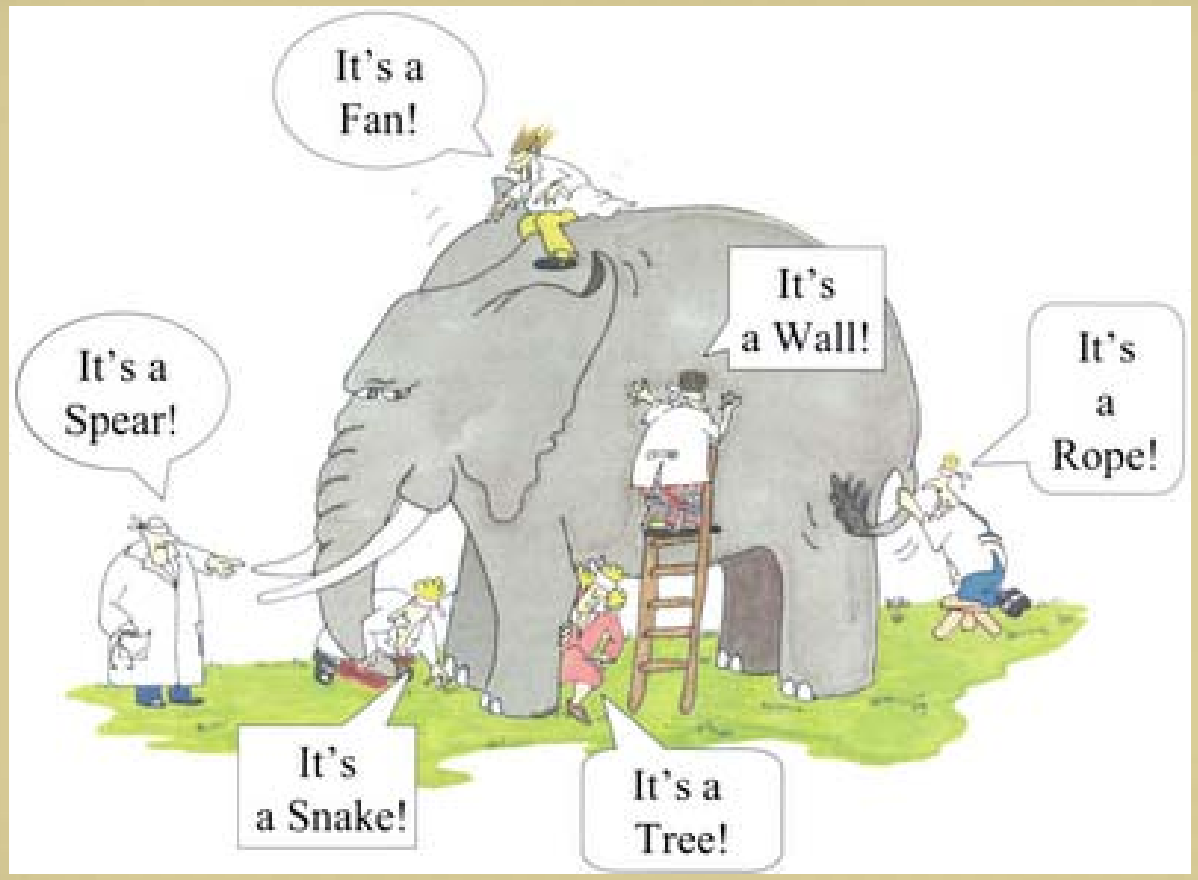
Source: http://www.aapm.org

Medical Physicists

Clinical Service and Consultation

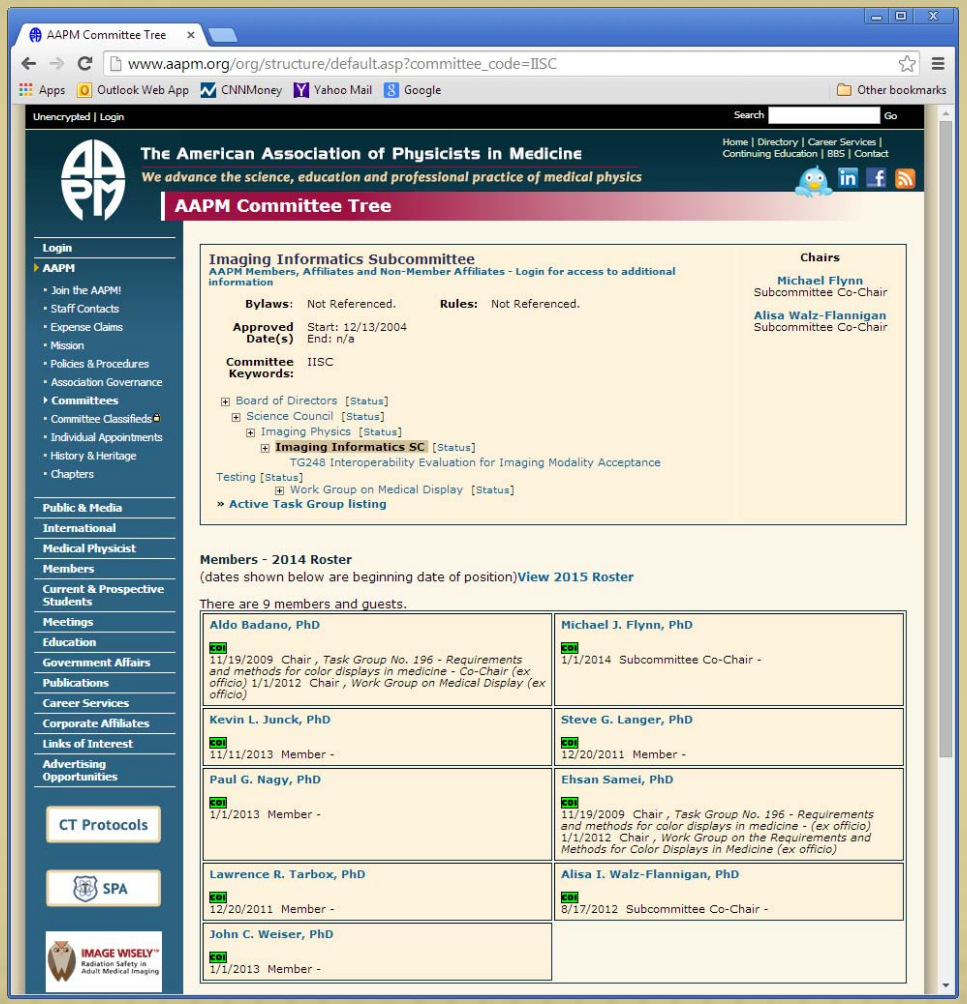
… Other important services are rendered through investigation of equipment performance, *organization of quality control in imaging systems*, design of radiation installations, and control of radiation hazards. *The medical physicist is called upon to contribute clinical and scientific advice and resources to solve the numerous and diverse physical problems that arise continually in many specialized medical areas*.

Who's On First?



Buy it or Build it

AAPM - IISC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Bylaws: Not Referenced.
Rules: Not Referenced.
Approved Date(s) Start: 12/13/2004 End: n/a
Committee Keywords: IISC
Board of Directors [Status]
Science Council [Status]
Imaging Physics [Status]
Imaging Informatics SC [Status]
TG248 Interoperability Evaluation for Imaging Modality Acceptance Testing [Status]
Work Group on Medical Display [Status]
» Active Task Group listing
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Subcommittee Co-Chair
Alisa Walz-Flannigan
Subcommittee Co-Chair
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(dates shown below are beginning date of position) View 2015 Roster
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Kevin L. Junck, PhD
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AAPM – TG 248


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Charge To develop a task group report which provides the following resources to the AAPM, applicable to all imaging modality areas: 1) Recommendation that the acceptance testing of imaging modalities includes end-to-end evaluation of image quality and image information from ordering system to long-term archive and all relevant systems where the images are viewed, processed or modified. 2) Background and motivation for interoperability assessment with examples identifying risks to patient care from incomplete acceptance testing. 3) Suggestions for tools for assessing interoperability. Further details will be developed by the TG in creating the report, with a better examination of what would be a useful role for the modality physicists and what resources are available to them.
Bylaws: Not Referenced. Rules: Not Referenced.
Approved Date(s) Start: 9/9/2013 End: 12/31/2015
Committee Keywords: TG248
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TG248 Interoperability Evaluation for Imaging Modality Acceptance Testing Interoperability Evaluation for Imaging Modality Acceptance Testing [Status]
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Alisa Walz-Flannigan
Task Group Co-Chair
John Weiser
Task Group Co-Chair
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AAPM – TG 248

Charge:

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AAPM – TG 248

1) Recommendation that the acceptance testing of imaging modalities includes end-to-end evaluation of image quality and image information from ordering system to long-term archive and all relevant systems where the images are viewed, processed or modified.

AAPM – TG 248

2) Background and motivation for interoperability assessment with examples identifying risks to patient care from incomplete acceptance testing.

3) Suggestions for tools for assessing interoperability. Further details will be developed by the TG in creating the report, with a better examination of what would be a useful role for the modality physicists and what resources are available to them.

Interoperability

Interoperability

TG 248 Report Introduction

The functionality of a diagnostic imaging system often extends beyond the acquisition console and depends on interoperability with a host of other systems such as RIS, PACS, post-processing software, treatment planning software, and clinical viewers. Interoperability might be assured by a vendor in an IHE (Integrating the Health Care Enterprise) Integration Statement, and perhaps contractually agreed to as part of a purchase. Or the vendor may assume no responsibility for interoperability and leave validation to the end-user to ensure that the equipment is ready for clinical use.

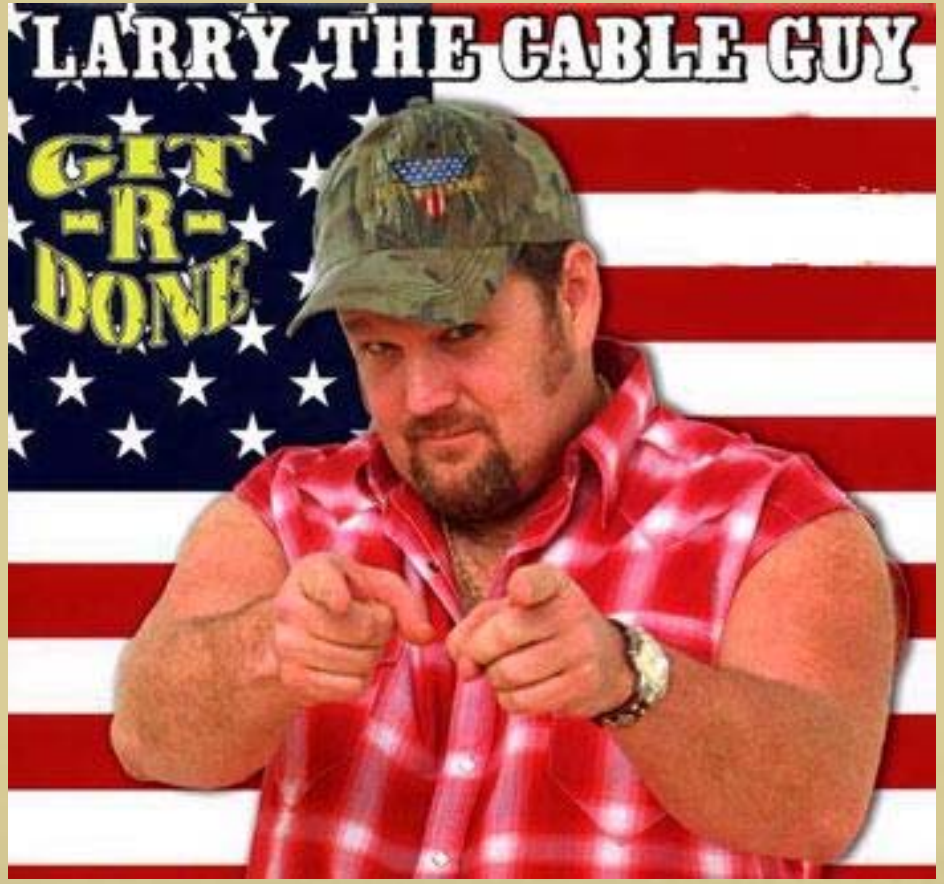
TG 248 Report Introduction

In either case, it is wise to understand what might go wrong, what the risks are, and what aspects of interoperability are desirable to validate as part of equipment acceptance testing. The goal of the acceptance testing can be viewed in two parts: 1) to ensure that the equipment meets or exceeds the specifications provided by the manufacturer as part of the purchase process. 2) To validate that a system is ready for clinical use. *Often it is the role of a physicist to be the final sign-off in regard to both of these acceptance testing goals.*

TG 248 Report Introduction

Troubleshooting and optimizing the imaging chain may require a team effort on the part of the physicist, service engineer, PACS system administrator, technologist and other stakeholders. Each of these individuals will have special knowledge of the workflow, the data flow and of the possible factors that could affect image quality and information integrity at different points in the imaging chain. *The medical physicist should have an understanding of the variables that can affect the image between acquisition and display, and to know where to go for additional assistance in order to isolate the source of image quality or information integrity problems.*

Team Lead



DICOM

Service Classes – “verbs” – Part 4

- Storage
- Storage Commitment
- Query/Retrieve
- *Modality Worklist*
- Modality Performed Procedure Step
- Printing

Modality Worklist

Before we generate an image, we want to link patient demographic information to the image – who's image is it?

A service typically provided by the PACS.

However it is a snapshot of the data provided by the RIS via HL7.

PACS v RIS

PACS – Pictures

communications with modality

RIS – Reports and Orders

communications with people (physicians, technologists)

PACS v RIS

PACS Broker

Receives HL7 from RIS

Translates into SQL calls for PACS database

Responds to modality requests for worklists

Modality Worklist Configuration

Place orders for your modality

do they show up?

do you get orders that are not for your area?

want to have a minimal list to avoid wrong selection, but must have what the user needs.

Modality Worklist

Error

typo in name/MRN/accession number

pick wrong set of Information from list

We've reduced the error rate, but the errors are more difficult to catch.

Modality Worklist Information

Place orders for your modality

what information is present?

Name, Gender, DOB

Accession Number, Date of exam, Type of exam – critical if you have multiple exams for same patient.

does exam “fall off” list when cancelled? when acquired?

Procedure Code Mapping

Tie the exam being performed to views or protocols on the modality.

Chest PA and Lateral – modality may step the technologist through acquiring the two images needed for this exam.

enables default techniques and image processing parameters

may be done by vendor's applications specialist

DICOM

Service Classes – “verbs”

- *Storage*
- Storage Commitment
- Query/Retrieve
- Modality Worklist
- Modality Performed Procedure Step
- Printing

Storage

Use Modality Worklist with a dedicated test patient to be able to send images to PACS.

Exception – matching of images against orders.

Image Processing – does it look right?

Image Annotations – are they there?

Physical measurements – pixels vs mm?

Storage

Image Manipulations:

Window – level

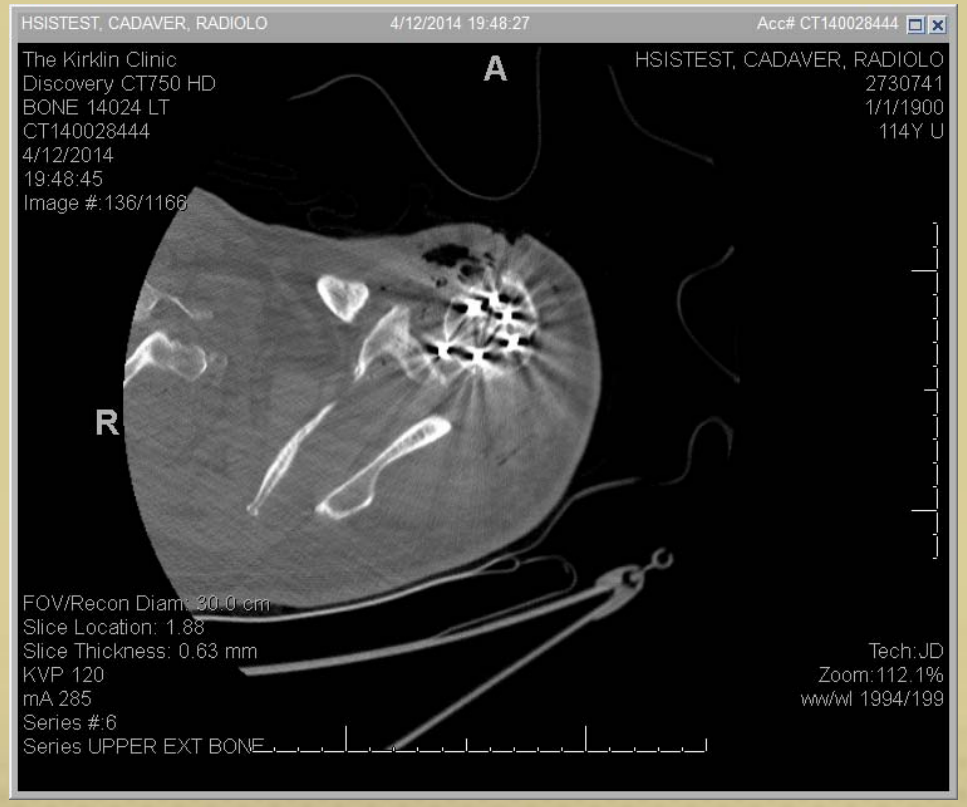
Flip / rotate

Invert

Edge Enhancement

Storage

Location markers – orientation



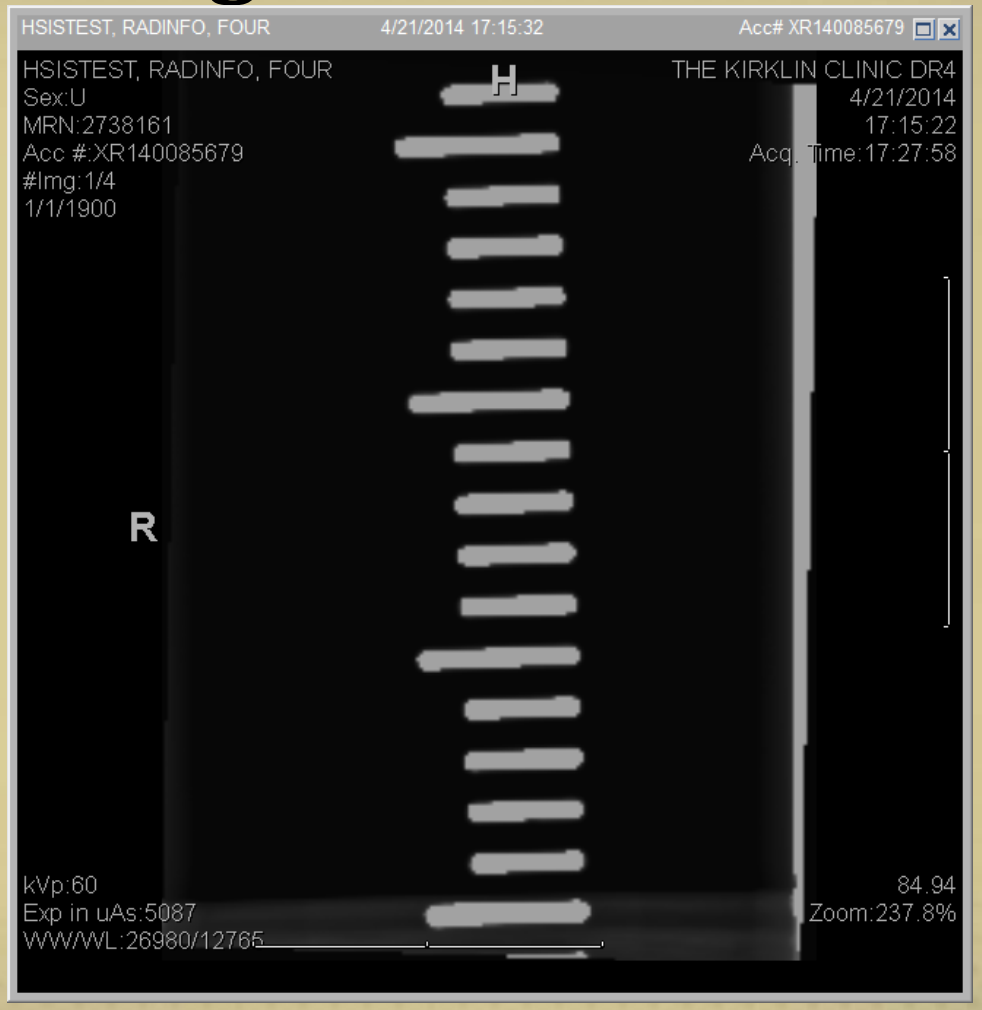
Storage

Network performance

Send to all locations - configuration

Storage

Image Overlay

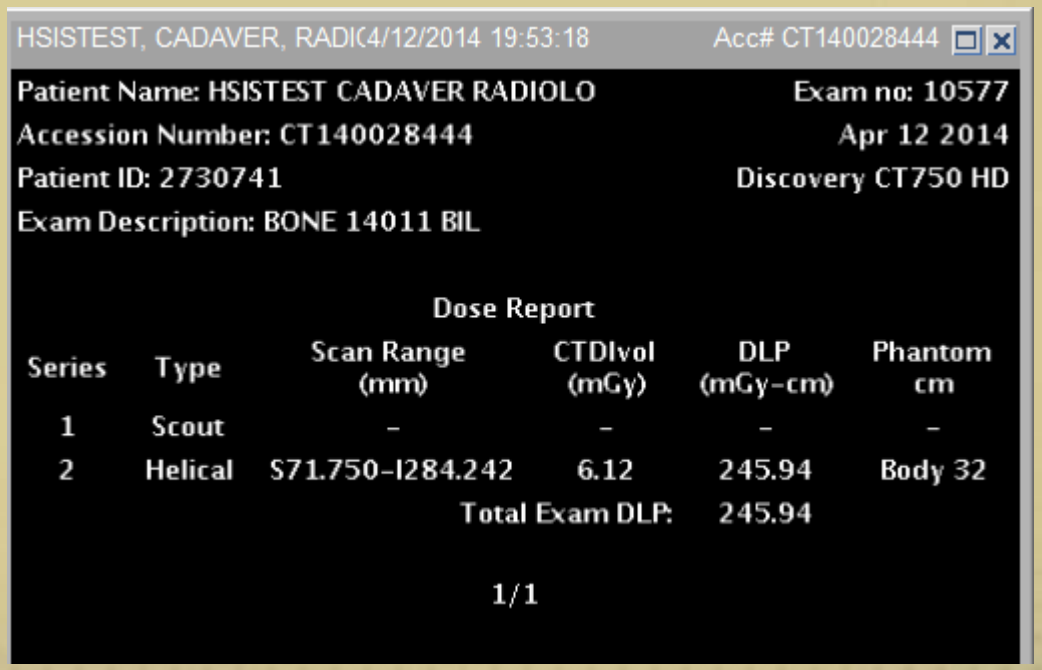


Storage

Non-image images

Structured report

Dose report


HSISTEST, CADAVER, RADI(4/12/2014 19:53:18 Acc# CT140028444

Patient Name: HSISTEST CADAVER RADIOLO Exam no: 10577

Accession Number: CT140028444 Apr 12 2014

Patient ID: 2730741 Discovery CT750 HD

Exam Description: BONE 14011 BIL

Dose Report

Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
1	Scout	-	-	-	-
2	Helical	S71.750-I284.242	6.12	245.94	Body 32
			Total Exam DLP:	245.94	

1/1

Storage

Error correction

Emergency data entry

Downtime procedures

- RIS
- PACS
- Network

HL7

Health Level 7

www.hl7.org

HL7 and its members provide a framework (and related standards) for the exchange, integration, sharing, and retrieval of electronic health information. These standards define how information is packaged and communicated from one party to another, setting the language, structure and data types required for seamless integration between systems. HL7 standards support clinical practice and the management, delivery, and evaluation of health services, and are recognized as the most commonly used in the world.

HL7

Start Block
MSH|^~\&|HNAMN|RADNET|PACS|UABHS|20140428101734||ORM^O01|Q1017569306T1090564180|X|2.3
PID|1|2738161|2738161||HSISTEST^RADINFO^FOUR||19000101090200|U||U|RAD INFO TEST
PT^/ BAD ADDRESS^BIRMINGHAM^AL^35222^USA^^^JEFFE|JEFFE|(999)999-9999||UNK|U|OTH|
648392053252||||NH|||0
PV1|1|I|UC~UABC~KRD^^^UC^^^UC~UABC|3|||9500^Universal^Provider^^^^^^^^^^DOCNBR~~~
9500^Universal^Provider^^^^^^^^^^EXTERNALID|||17|UC~UABC~KRD|||1||||O|3252||||||
||||||||||||||UC|||||20130909124000|20130923235959
ORC|NW|1685047828^HNAM_ORDERID|||||||20140428101700|411234561^Tester^Kelly^^^^^^
^^^^EXTERNALID||9500^Universal^Provider^^^^^^^^^^DOCNBR~~~9500^Universal^Provide
r^^^^^^^^^^EXTERNALID|||20140428101730|||WRITTEN ORDER^Written|411234561^Tester^
Kelly^^^^^^^^^^EXTERNALID
OBR|1|1685047828^HNAM_ORDERID||CD:51536620^MA Mammogram Digital Bilateral|||||||
|CD:312689^312689|||Rad Type&Rad Type|9500^Universal^Provider^^^^^^^^^^DOCNBR~~~
9500^Universal^Provider^^^^^^^^^^EXTERNALID||||00000MA20140010066^HNA_ACCN~30784
024^HNA_ACCNID~5905455^HNA_PACSID|CD:185639490|20140428101730||Mammography|||1^^
0^20140428101700^^Today|||Ambulatory|^test
End Block

HL7

MSH|^~\&|HNAMN|RADNET|PACS|UABHS|20140428101734||ORM^O01|Q1017569306T1090564180|X|2.3

MSH – message header

MSH 3 and 4:Sending Application/Facility – HNAMN/RADNET

MSH 5 and 6: Receiving Application/Facility – PACS/UABHS

MSH 7: Date/Time of Message

MSH 9: Message Type

- ORM – order
- ORU - result

HL7

PID|1|2738161|2738161||HSISTEST^RADINFO^FOUR||1900010
1090200|U||U|RAD INFO TEST PT^/ BAD
ADDRESS^BIRMINGHAM^AL^35222^USA^^^JEFFE|JEFFE|(999)
999-9999||UNK|U|OTH|

648392053252||||NH|||0

PID – Patient Identification

PID 3 – Patient Identifier

PID 5 – Patient Name

PID 7 – Patient DOB

PID 8 – Gender

PID 18 – Financial Account Number

HL7

PV1|1|I|UC~UABC~KRD^^^UC^^^UC~UABC|3|||9500^Universal
^Provider^^^^^^^^^^DOCNBR~~~9500^Universal^Provider^^
^^^^^^^^EXTERNALID|||17|UC~UABC~KRD|||1||||O|3252||||||
||||||||||||||UC|||||20130909124000|20130923235959

PV1 – Patient Visit

PV1 2 – Patient Class

PV1 3 – Patient Location

PV1 7 – Attending Doctor

HL7

ORC|NW|1685047828^HNAM_ORDERID|||||||20140428101700|411234561^Tester^Kelly^^^^^^^^^^EXTERNALID||9500^Universal^Provider^^^^^^^^^^DOCNBR~~~9500^Universal^Provider^^^^^^^^^^EXTERNALID|||20140428101730|||WRITTEN ORDER^Written|411234561^Tester^Kelly^^^^^^^^^^EXTERNALID

ORC – Order Common Information

ORC 1 – Order Control Code / Status

ORC 10 – Entered By

HL7

OBR|1|1685047828^HNAM_ORDERID||CD:51536620^MA Mammogram Digital Bilateral|||||||CD:312689^312689|||Rad Type&Rad Type|9500^Universal^Provider^^^^^^^^^^DOCNBR ~~~9500^Universal^Provider^^^^^^^^^^EXTERNALID||||0000 0MA20140010066^HNA_ACCN~30784024^HNA_ACCNID~59054 55^HNA_PACSID|CD:185639490|20140428101730||Mammograp hy|||1^^0^20140428101700^^Today|||Ambulatory|^test

OBR – Observation Request

OBR 2 – Placer Order Number

OBR 4 – Universal Service ID

OBR 20 – Filler Field 1

DICOM

DICOM — Digital Imaging and Communications in Medicine — is the international standard for medical images and related information (ISO 12052). It defines the formats for medical images that can be exchanged with the data and quality necessary for clinical use. DICOM is implemented in almost every radiology, cardiology imaging, and radiotherapy device (X-ray, CT, MRI, ultrasound, etc.), and increasingly in devices in other medical domains such as ophthalmology and dentistry. With tens of thousands of imaging devices in use, DICOM is one of the most widely deployed healthcare messaging standards in the world. There are literally billions of DICOM images currently in use for clinical care. Since its first publication in 1993, DICOM has revolutionized the practice of radiology, allowing the replacement of X-ray film with a fully digital workflow. Much as the Internet has become the platform for new consumer information applications, DICOM has enabled advanced medical imaging applications that have “changed the face of clinical medicine”.

DICOM

References

http://dicom.nema.org

Part 3 – Information Object Definitions – nouns

Part 4 – Service Classes - verbs

Part 6 – Data Dictionary

Part 14 – Grayscale Standard Display Function

DICOM

Information Object definition – noun

data object which contains attributes which describe the complete set of data needed to define an image.

some portions are modality specific, others are common amongst IODs.

DICOM

Information Object definition – noun

patient: name, MRN, DOB, gender

exam: accession number, type of exam, ordering physician, date of scan

acquisition: kVp, slice thickness, vendor of scanner, image number, series number

DICOM

Service Object Pair (SOP) class

take one service (verb) and pair it up with one object (noun)

MR Storage SOP class

CT Storage SOP class

CT Print SOP class

DICOM

Storage Class

- two roles
  - User
  - Provider

Storage class – user is the sender and the provider is the receiver

DICOM

Unique Identifier (UID)

string of numbers which uniquely identifies something

SOP Class

CT Image Storage 1.2.840.10008.5.1.4.1.1.2

Study 2.16.840.1.114151.4.1615.41755.4913.13414138

Series 1.2.840.113704.1.111.1772.1398716689.10

Image 1.2.840.113704.1.111.8980.1398716775.102112