Medical Physicists, the DICOM Standard and Working Group 28

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DICOM Review

- Utilizes an open standards development process that encourages the involvement and consensus of both manufacturers and users
- Specification of a conformance mechanism so that a user can determine whether or not devices are likely to interoperate

DICOM Standards Committee (DSC)

- DICOM Standards Committee (DSC)
  - DICOM’s executive body whose members are imaging equipment manufacturers, physician organizations, and other interested groups
    - 27 manufacturer members
    - 20 user members
    - 11 general interest members
  - AAPM now a voting member of the DSC as a “User” organization
  - AAPM’s activities are coordinated through MITA, a division of the National Electrical Manufacturers Association (NEMA)

List of Working Groups (WG)

- WG-01: Cardiac and Vascular Information
- WG-02: Projection Radiography and Angiography
- WG-03: Nuclear Medicine
- WG-04: Computed Tomography
- WG-05: Exchange Media
- WG-06: Base Standard
- WG-07: Radiology
- WG-08: Structural Reporting
- WG-09: Ophthalmology
- WG-10: Striptease/Military
- WG-11: Display Function Standard
- WG-12: Ultrasound
- WG-13: Visible Light
- WG-14: Security
- WG-15: Digital Radiography and CAD
- WG-16: Magnetic Resonance
- WG-17: CT
- WG-18: Clinical Trials and Education
- WG-19: Dermatologic Standards
- WG-20: Integration of Imaging and Information Systems
- WG-21: Computed Tomography
- WG-22: Dentistry
- WG-23: Application Hosting
- WG-24: Surgery
- WG-25: Veterinary Medicine
- WG-26: Pathology
- WG-27: Web Technology for DICOM
- WG-28: Physics
DICOM "workflow"

- Working groups propose "Work Items" based on suggestions from members, users or at the direction of the DSC
- Work Items are divided into Supplements and Change Proposals (sometimes called Correction Proposal or Items)
  - Supplements define new objects, content or structure
  - Change Proposals modify the existing Standard

DICOM Standard Status*

Table of Contents
- Final Text Differences (additional to 2011 Base Standard)
- Final Text Differences (additional to 2008 Base Standard)
- Final Text Differences (additional to 2005 Base Standard)
- Final Text Differences (additional to 2002 Base Standard)
- Final Text Differences (additional to 1999 Base Standard)

* http://medical.nema.org/

DICOM "workflow"

- Base Standards working group (WG06) maintains the overall consistency of the DICOM standard
  - Some of WG06 responsibilities include:
    - Execution of the DICOM Maintenance Process (i.e. development of Change Proposals)
    - Technical coordination and guidance for all WG's
    - Review and official approval of all Work Items before Public Comment, Letter Ballot and Final Text releases
- Once the Work Item is complete, WG06 petitions the DSC to approve the Work Item and it is sent out for Public Comment

New DICOM Working Group

- Recently the DSC established a Working Group on Physics (i.e. WG28)
  - Established at 2011 RSNA

| WG-01: Cardiac and Vascular Information | WG-15: Digital Mammography and CAD |
| WG-02: Projection Radiography and Angiography | WG-16: Magnetic Resonance |
| WG-03: Nuclear Medicine | WG-17: 3D |
| WG-04: Congruency | WG-18: Clinical Trials and Education |
| WG-05: Exchanging Data | WG-19: Dermatologic Standards |
| WG-06: Base Standard | WG-20: Integration of Imaging and Information Systems |
| WG-07: Radiotherapy | WG-21: Computed Tomography |
| WG-08: Structured Reporting | WG-22: Dentistry |
| WG-09: Ophthalmology | WG-23: Application Hosting |
| WG-10: Strategic Advisory | WG-24: Surgery |
| WG-11: Display Function Standard | WG-25: Veterinary Medicine |
| WG-12: Ultrasound | WG-26: Pathology |
| WG-14: Security | WG-28: Physics |
WG28 Physics

Currently has Chairs and Secretariats from both Europe and United States

Recommendation is to also have a manufacturer Co-Chair

Scope

- To develop or consult on Supplements and Change Proposals requiring detailed expertise on physics and/or the needs and work of medical physicists

- To serve as a liaison body to facilitate including data relevant to the physics community in the DICOM Standard

Risks Identified

- Physics wish-list could get too far ahead of vendor and user expectations

- Might not be able to recruit enough physicists, equipment vendors & service providers for the resulting specifications to be effective, balanced and adopted

WG28 Physics - Current Roadmap:

1. Evaluation of the accuracy of data registered in the DICOM Radiation Dose Structured Report (SR)

2. Definition of details for patient organ dose

3. Methods for capturing and recording operator dose

Structured Report (SR)

- Supplement 23 for new Image Object Definition (IOD)
  - approved in April 2000
- Support for conventional free text reports and provide the capability to record structured information
  - Convey the interpretation text and record the DICOM identifiers (i.e. attributes) of selected images and/or data
- Information stored in "Templates" (TID)
  - Templates are given in Part 16: Content Mapping Resource

Radiation Dose SR

- Used to convey exposure characteristics and dose from X-Rays generated by imaging devices
  - Therapeutic dose is reported in RT Dose IOD
- Records "radiation output" information, not patient dose

Radiation Dose SR - Projection Radiography

- TID 1002
  - General attributes for:
    - Subject, procedure and observer (i.e. operator)
- TID 10002
  - Container for accumulated x-ray dose for all irradiation events
- TID 10003
  - Dose and equipment parameters from each irradiation event, e.g.:
    - X-ray exposure techniques
    - Table, Gantry Angle, Beam Geometry, ...
    - Dose measurement values
- TID 10004
  - Detailed accumulated dose for all irradiation events
Correction Proposal – Add CR/DR to RDSR

- CP1077 approved April 2012
- Adds ability to include dose information from all types of digital detector systems
- Three integration options:
  - X-ray detector data available
  - Integrated
  - Cassette-based
  - X-ray source data available
  - X-ray mechanical data available

Radiation Dose SR – CT Radiation Dose

- TID 10012
  - Detailed accumulated CT dose for all irradiation events
- TID 10013
  - Dose and equipment parameters from each irradiation event
- TID 10014
  - Scan exposure range information
- TID 100015
  - Dose check alert values

Development of Patient Dose SR Work Item

- Current Radiation Dose SR contains only information about the x-ray system or information the x-ray system can determine, e.g.:
  - radiation output, geometry, x-ray source, detector system, etc.
- Estimation of patient or organ dose requires:
  - X-ray system information
  - Models of the patient/organs
  - Radiation interaction within the patient
- Methods to do patient dose estimations are being developed and improved continuously
  - storage of these estimations in a different object would allow more versatile utilization of the data

Patient Dose SR: Data Flow/Requirements

- X-Ray Equipment
- Modality IOD
- Radiation Dose SR
  - X-Ray exposure techniques
  - Table, Gantry Angle, Beam Geometry, collimation, ...
  - Dose measure: CTDI, DAP, …
- Organ Dose Calculation System
Patient Dose SR: Data Flow/Requirements

- Modality Frame of Reference
  - X-Ray exposure techniques
  - Table, Gantry Angle, Beam Geometry, collimation, ...
  - Dose measure: CTDI, DAP, ...

- Radiation Dose SR
  - X-Ray exposure techniques
  - Table, Gantry Angle, Beam Geometry, collimation, ...
  - Dose measure: CTDI, DAP, ...

- Equipment Information
  - Table dimension
  - Absorption material, ...
  - Equipment Information
  - Table dimension
  - Absorption material, ...

- Patient-to-Equipment Registration System
  - Patient position on table
  - Fiducials

- Patient Registration Information
  - Actual scan range
  - Patient position on table
  - Fiducials

- Patient Dose Surface
  - 2D view/map (e.g. iso-dose map)

- Patient Dose SR
  - Calculated data for documentation and reference to images and other SR's

Patient Dose SR: Requirements for Organ Dose

- Calculation Information
  - Algorithm details
  - Assumptions of calculation model
    - Table attenuation, backscatter model, ...

- Interpretation of Results
  - Accuracy/Uncertainty model

- Referenced Objects (UID's)
  - Irradiation context: Radiation Dose SR – one or more?
    - Patient model: skin surface, organs, ...
  - Patient location and orientation: registration, fiducials, ...
    - 2D map or 3D dose map: Iso-dose image, ...

- Calculated Data for Documentation
  - Peak Dose locations
  - Iso-dose lines
  - Registry data

Development of Operator Dose SR Work Item

- Personal Dosimetry Management System (PDMS)
  - An external system independent from the x-ray system that has the ability to register the dose received by operators of radiographic equipment procedure, e.g.:
    - Interventional radiography
    - Cardiology

- Termed "ambient dose" from procedure

- Ability to register the ambient dose of the equipment for each x-ray procedure
Operator Dose SR: Data Flow/Requirements

- During each X-Ray procedure, the PDMS:
  - gathers the dose of all operators who participate in a procedure
  - generates the Operator Dose SR at the end of the procedure

MITA Interventional Working Group

- User Quality Control Mode
  - Standard that applies to x-ray equipment intended to perform interventional procedures
  - Defines a set of minimum requirements designed to more easily facilitate quality control at the facility level
  - Items pertinent to the following quality control elements are contained in the Standard:
    - physical testing of equipment
    - electronic audit of system configuration
    - electronic reporting of relevant data and information

Goals - User Quality Control Mode

- Provide a set of quality tools on imaging equipment for:
  - Quality Control testing to detect degradation of X-ray related components.
  - Access to and export of "for processing", and "for presentation" images suitable for external digital image quality testing
  - Calibration inputs from the physicist required for fields in the Radiation Dose Structured Report (RDSR)
  - Electronic documentation of system configuration and technical factors invoked by each Exam Protocol Selection Button (EPSB)
  - Export in spreadsheet format
  - Access to RDSR