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Integrating Imaging with Information Systems

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Diagnostic and interventional imaging plays an increasingly large role in any hospital or healthcare provider organisation. Digital images and associated data will constitute an integral part of the electronic patient record and enter into new application fields such as molecular imaging. In addition to representing a significant share of costs and revenues, imaging is intricately integrated into the clinical workflows of patient assessment, admission and care. Consideration of imaging results is essential for clinical decision making. Accordingly, the integration of imaging and information systems plays a key role in the optimisation of patient care processes and the utilisation of costly imaging assets.

Standards for Imaging Integration

Achieving this integration in the complex multivendor settings of modern healthcare requires standards. Indeed, the prime function of standards is to foster interoperability and facilitate interconnection across proprietary boundaries for the exchange of relevant healthcare data (see Figure 1).

DICOM-HL7 Collaboration

The DICOM Standards Committee and HL7 created a common DICOM-HL7 working group in 1999. DICOM Working Group 20 (Integration of Imaging and Information Systems) and the HL7 Imaging Integration Special Interest Group (IISIG) have common membership and always meet jointly. Based on the memorandum of agreement between HL7 and the DICOM Standards Committee, the standards developing organisations work together in a very constructive way. For standardisation efforts in the intersection of their domains, DICOM and HL7 harmonise concepts to promote interoperation between the imaging and healthcare enterprise domains. Thus the same group of people is recognised by both organisations and has standing to propose changes or extensions to either standard as appropriate.

Completed and ongoing projects of the HL7 IISIG / DICOMWorking Group 20 expand opportunities for standards-based connectivity:

The Main Standards that are in Use in Imaging Enterprises are:

• DICOM (Digital Imaging and Communications in Medicine) 1 - defines protocols and data formats for communication and storage of biomedical

diagnostic and therapeutic images and image-related data. DICOM is recognised as an International Organisation for Standardisation (ISO) standard and maintained by the DICOM Standards Committee, an independent international standards development organisation. DICOM is mainly used within imaging departments for communications between imaging devices, Picture Archiving and Communications Systems (PACS) and imaging department information systems, such as Radiology and Cardiology Information Systems.The DICOM standard is universally accepted for the transport of image data between imaging device and image management systems. Since its introduction in 1993, DICOM connectivity has grown from an extra cost option to a standard equipment function on nearly all diagnostic imaging devices.

• HL7 (Health Level Seven) 2 - defines messages, services and document formats for communication of clinical patient care information across and between healthcare enterprises for the delivery and evaluation of healthcare services. HL7 is an ANSI (American National Standards Institute) accredited standard supported outside the USA by 27 national affiliate organisations. In imaging, HL7 standards are mainly used to communicate patient demographic and clinical information, orders, results, and billing information between imaging departments and their parent enterprises.

• Terminologies - terminology standards such as the Systematised Nomenclature of Medicine (SNOMED)3, Logical Observation Identifiers Names and Codes (LOINC)4 and the Unified Code for Units of Measure (UCUM) 5 are used in both DICOM and HL7 implementations to represent anatomical sites, clinical findings, measurements and observations.

• IHE (Integrating the Healthcare Enterprise) 6. While not technically a standard, IHE defines, in its publishedTechnical Frameworks, a set of Implementation Profiles specifying standards-based solutions for common interface and integration problems. For example, IHE ScheduledWorkflow profiles describe in detail the combination of HL7 and DICOM interfaces necessary to support the worklist- based tracking of scheduled and performed imaging procedure steps.

- HL7 Version 2.5:

Order Message for Imaging (OMI) Message

Status: Approved ANSI Standard In HL7 Version 2.5 II SIG / WG20 has specified an imaging order message used for internal scheduling of imaging procedures. This order message contains information for imaging devices on the tasks and steps that are required to fulfill the imaging service request.

- HL7 V3:

Imaging Order and Results Messages based on Generic Order and Results Model

Status: Work in progress Similar efforts are under way for HL7 Version 3. IISIG / DICOM WG20 is working on imaging-specific order and results messages. The new messages will allow better communication of imaging department medication and contrast administration to the enterprise, and support more detailed enterprise workflow management.

- DICOM Supplement 101 "HL7 Structured Document Object References"

Status: Approved DICOM Standard In order to facilitate access to clinical documents outside the imaging domain, this supplement specifies extensions to the DICOM standards that allow to reference relevant HL7 Clinical Document Architecture (CDA) documents and to store CDA documents on DICOM removable media. Supplement 101 also describes methods for referencing and using DICOM annotation in HL7 reports.

- HL7 V3 Message and Report Patterns

Status: HL7 Committee Ballot HL7 V3 Common Message Element Types (CMET) are used to specify the patterns that are needed to reference and retrieve DICOM objects such as relevant images within CDA documents and V3 messages.

- CDA Diagnostic Imaging Report Implementation Guide

Status: Work in progress

A CDA implementation guide adds explanations and constraints that specialise CDA for particular clinical uses. IISIG/ WG20 is developing such a guide that describes diagnostic imaging reports encoded as CDA documents. The implementation guide also specifies the transformation of DICOM SR simple image and numeric reports into CDA documents.

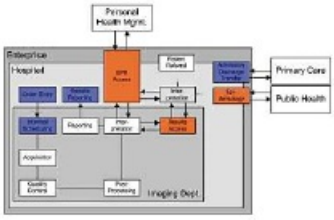

Figure 1: The importance of imaging integration. A typical patient care episode starts and ends outside the imaging department (admission and discharge). Order entry and results reporting are traditionally the main interfaces of the imaging department to the hospital and healthcare enterprise environment. Access to clinical information (Electronic Patient Record (EPR), EPR Access), imaging results and public health epidemiological data facilitate the flowof information in the entire healthcare enterprise.

- Mapping of DICOM Structured Reports to the HL7 CDA Documents

Status: Work in Progress

The goal of this effort is to facilitate the exchange of imaging report contents within and beyond the healthcare enterprise. Members of DICOMWG20 / HL7 II SIG are actively participating in the DICOM reporting strategy discussion where future directions for the use of DICOM SR and the CDA are determined.

- Workflow Model for Cross-Departmental Communication of Task Information

Status: Work in progress

Most diagnostic imaging equipment today supports DICOM Modality Worklist, a service that eliminates manual entry of patient and order data into imaging devices. Standards are mature for DICOM Performed Procedure Step functions, which imaging devices may use to report procedure status and completion to departmental information systems, and systems with these features are appearing in the market. There is a lack of standards that support the communication of task information between imaging and clinical domains. In order to address enterprise workflow management support II SIG /WG20 has proposed a common DICOM / HL7 workflow model.

Ready For Integration

DICOM and HL7 standards are ready for today's challenges in imaging integration. Current work in progress will enable more effective connectivity and efficient operations in the future.

• For image communications with mainstreamradiology and cardiology modalities,

DICOM standards are so universally accepted as to be inescapable. Other medical imaging applications such as ophthalmology and pathology are now seeing the benefits of DICOM standard image communications,

• Modality Worklist is widely available and enhances productivity and reduces data entry errors, and should be adopted now wherever available,

• Modality Performed Procedure Step closes the loop of interaction between imaging devices and information systems, allowing exam completion information to be recorded without extra process steps on information system terminals. Providers should demand and adopt these features when procuring systems,

• DICOM Supplement 101 now enables reporting integration that records radiologist annotation in standard DICOM Key Image Note (KO) and optional Gray Scale Presentation State (GSPS) objects that can be communicated to other vendors' systems,

• HL7 V3 standards now in development will enable more efficient and reliable communication of medication and contrast agent administration information, and

• Version 3 standards will also support detailed enterprise workflow management that tracks progress of imaging procedure steps, enabling more efficient coordination of activities and resources.

For a complete list of references contained in this article, please contact k.ruocco.me@eahitm.org.

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