Image Sharing: Evolving Solutions in the Age of Interoperability

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Interoperability is a major focus of the quickly evolving world of Health IT. Easy, yet secure and confidential exchange of imaging exams and the associated reports must be a part of the solutions that are implemented. The availability of historical exams is essential in providing a quality interpretation and reducing inappropriate utilization of imaging services.

Today, the exchange of imaging exams is most often achieved via a compact disc. We describe the virtues of this solution as well as challenges that have surfaced. Internet- and cloud-based technologies employed for many consumer services can provide a better solution. Vendors are making these solutions available.

Standards for Internet-based exchange are emerging. Just as radiology converged on DICOM as a standard to store and view images, we need a common exchange standard. We will review the existing standards and how they are organized into useful workflows through Integrating the Healthcare Enterprise profiles. Integrating the Healthcare Enterprise and standards development processes are discussed. Health care and the domain of radiology must stay current with quickly evolving Internet standards.

The successful use of the "cloud" will depend on both the technologies and the policies put into place around them, both of which we discuss. The radiology community must lead the way and provide a solution that works for radiologists and clinicians with use of the electronic medical record. We describe features we believe radiologists should consider when adding Internet-based exchange solutions to their practice.

Key Words: Cloud, CDs, IHE, data security, inappropriate utilization

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OVERVIEW

The appropriate, secure, and confidential exchange of protected health-related information (PHI) such as imaging exams and reports has long been an essential part of quality medical care in general, and radiology practice in particular. The principal reason to exchange data has been to establish a longitudinal imaging record for the patient and provide a history of examinations, usually to compare with a current examination. In addition, patients often receive care from multiple providers or institutions, resulting in fragmentation of data. This disconnect may lead to duplicative examinations, which are often associated with unnecessary cost and radiation exposure. Ready availability of appropriate image-exchange technology may help avoid duplication and its untoward byproducts [1-3].

What constitutes image sharing? Sharing the information content of images is the primary objective. However, if a report has already been furnished at the originating site, its transmission is a key element of the information exchange, and in some circumstances, the report may be as important to securely share as the images themselves. Both images and reports contain metadata that are often useful in the management of the patient. Thus, different constituents such as referring physicians or other specialists will require different data elements. The number of actors interested in and related to patient images and imaging reports is expanding [1-3]. In the rapidly changing health care environment, image and report sharing are growing in importance for several additional reasons.

Image Sharing—Why?

Image sharing provides the following benefits:

- Availability of a historical exam during interpretation of a current study may improve the quality of interpretation;
- Inappropriate utilization (duplicate exams) is decreased by making prior and complementary exams easily accessible, thus reducing health care costs [4,5];
- Radiation exposure is decreased, to the individual patient and the general population, by avoiding exam duplication;
- Diagnostic information from one imaging exam, which is often needed by multiple care providers when

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caring for the same patient, can be made available at various sites;
- Images and reports can be contemporaneously available at the point of care.

Image Sharing—Who Participates?

The following functions and environments play a role in image sharing:

- Primary interpreting radiologist (site generating the initial data)
- Referring physician
- Consulting physician
- Other radiologist ("2nd opinion")
- Other hospital(s) or health care enterprise
- Clinical trial
- Patient
- Patient surrogate

Image Sharing—How?

Image sharing can be accomplished through the following means:

- PACS access
- Film
- Compact disc (CD)
- Online (Internet, "cloud")

A PACS can itself be employed as a means of sharing images. Access rights to a PACS can be extended to providers outside the local enterprise. Security and confidentiality risks are associated with extending privileges to individuals not normally credentialed in an enterprise PACS. One must take care to see that the appropriate legal agreements, policies, and practices are put into place and explained to the "outside" user. Keep in mind that one is usually opening the door to the entire archive in such a scenario.

Film-based image interpretation still exists, particularly in the offices of nonradiologist providers. These exams may provide relevant information in the evaluation of the patient. Offices that produce primarily film are rarely capable of creating copies. Thus, patients shoulder the burden of carrying the only existing copy, ie, the one from the original examination, to subsequent providers. This process is cumbersome but should not be bypassed, particularly when the prior exam can assist in the treatment of a patient. Radiology offices frequently digitize and import these exams into a PACS. A tradeoff results from easier accessibility to the data versus degradation of the exam in the process of importation.

Conceptually, the CD appeared to provide the ideal solution for image exchange. Despite the significant advantages of CDs as a transport medium compared with film, several challenges have arisen. CDs remain the most common means of exchanging imaging data, and several steps can make this process more useful and less burdensome.

Online image exchange using the cloud is now available. In other areas of life, businesses have become accustomed to moving many types of information via the Internet. Music, photos, videos, and financial information are some of the data transferred using cloud technology. Society clearly finds this means of information exchange efficient and desirable. Acceptance of this relatively secure exchange of confidential information across the Internet indicates a reasonable level of trust by users of this technology. However, the challenge of ensuring the highest level of security and confidentiality for Internet-shared health care data is not trivial. Experience with the current, commonly used data types may inform the pursuit of health care information exchange.

Current and future Internet technologies are exciting, dynamic, and offer opportunities to promote the seamless exchange of health care data. As newly developed solutions are implemented, they must take into account the fact that the medical imaging profession has experienced tremendous growth, in part through the observance of standards such as DICOM and Health Level 7 (HL7). Ideally, new exchange technologies will respect these standards that support hardware interoperability while leveraging the advantages of Internet-based information exchange.

Both DICOM and HL7 are constantly evolving. A current focus is to keep both current with modern Internet technology. Many applications we all use daily on the Internet are based on RESTful services. REST is an acronym for Representational State Transfer. This architecture is commonly used by large organizations, including Google, Yahoo, Microsoft, and Amazon, to communicate with end-users through a browser. This efficient means of communicating information allows more-complex processing behind the scenes.

New DICOM RESTful services are intended to allow the imaging field to leverage these modern Internet technologies. These services include QIDO-RS (query based on ID for DICOM objects by RESTful Services) to query for images, WADO-RS (web access to DICOM objects using RESTful Services) to retrieve images, and STOW-RS (store over the web by RESTful Services) to store imaging data. HL7 is in the midst of its Fast Healthcare Interoperable Resource Project (FHIR®). In a similar manner, this project is intended to bring RESTful services to the HL7 standards.

INTEGRATING THE HEALTH CARE ENTERPRISE

Integrating the Healthcare Enterprise (IHE) is an endeavor founded in 1998 and formally incorporated in 2007; the IHE mission is directed at enabling transparent interoperability between the many systems used throughout health care enterprises. This interoperability is accomplished by identifying common workflows, the systems used, the transactions between these systems, and the existing standards (DICOM, HL7, etc.) that might be employed for these transactions. End-users, engineers,