The Imaging Continuum

Interoperability Among Disparate PACS Systems Whitepaper

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Abstract

When knowledgeable healthcare IT professionals are asked about medical imaging workflow, it is highly probable that they will speak to the use of Picture Archiving and Communication Systems (PACS). This is understandable given the widely held notion of PACS as a critical component within this complex medical imaging workflow. From scheduling, to acquisition, to technologist review, to specialist interpretation, and the image enablement of the referring physician at the point of care, PACS plays a crucial role throughout this workflow. Over the past 15 years or so, PACS workflow has continued to be enhanced and standardized, producing improved IT interoperability which in turn has yielded improved clinical care at a lower cost.

Notwithstanding the importance of PACS in the medical imaging workflow, the importance of image data ownership, access and sharing across the enterprise is growing at a rapid pace. As images move within (and outside of) the healthcare enterprise, attributes within the image data often require normalization to enable proper viewing. Patient identifications, study descriptions, modality types, organ codes, and other DICOM attributes may need to be normalized so that the study is correctly presented to physicians and clinicians. More advanced challenges exist where images require compression, transfer syntax conversion or proprietary PACS presentation state and annotation transformations to enable viewing in another PACS. The question is, how can any healthcare system, RHIO, or national health system tackle these challenges across numerous disparate PACS and modalities? How can they own and control their imaging data so that they can improve access and sharing?

This whitepaper identifies solutions to these challenges through outlining the Clinical Imaging Continuum. Simply stated, the Clinical Imaging Continuum is a lifecycle view of image data from its creation at a modality, to its review by specialist physicians, its storage in the long-term archive, its inclusion in the EMR, through its recall from the archive for use as a relevant prior or for clinical research. The Clinical Imaging Continuum details this image data lifecycle and presents solutions that result in image data ownership, access, and sharing across an enterprise, RHIO, or national health system.

The Growing Importance of Image Data Ownership, Access, and Sharing

The importance of image data ownership, access, and sharing is being driven by market factors.

1. Customers making second generation PACS decisions are quickly learning that moving from the incumbent PACS to a new PACS can be labor-, time- and cost-prohibitive due to the need to migrate long-term archive image data. Typically, long-term archives are part of the incumbent PACS, and it is common that the image data in the long-term archive is stored in a PACS vendor-proprietary format. Healthcare enterprises confronting this situation want to move to a PACS-neutral or vendor-neutral archive, thereby finally achieving ownership of their image data.

2. Interoperability across numerous departmental and site PACS solutions within any enterprise can be a challenge. Sharing of image data across disparate PACS solutions through routing, fetching, and query/retrieve functions can pose conflicts through out-of-synch attributes (study descriptions, modality types, etc.), conflicting accession numbers, bandwidth limitations, and more. Users confronting these situations want to be able to share their image data through an intelligent engine providing DICOM normalization and advanced rules-based communication mechanisms that can be managed without the need for professional services.

3. Image-enabling the EMR is a top priority in today's integrated health enterprise. Most health systems have multiple PACS (e.g., radiology, cardiology, echo, cath lab, dental, etc.). Integrating these PACS with the enterprise EMR can be a costly and time-consuming task. Educating end-user clinicians on different PACS viewers tied to specific PACS can present end-user adoption challenges. Users confronting this situation want to be able to have their image data stored in a single, PACS-neutral / Vendor-neutral archive (VNA) so that they can access data using a DICOM viewer of their choice via integration with their EMR.

4. Access to image data for teaching and/or research is of growing importance. Again, given the fact that there are multiple PACS within a healthcare enterprise, the ability to scan image data and retrieve relevant image data for inclusion in non-diagnostic teaching or research initiatives is difficult to attain. Access to this image data must be achieved with vendor and/or 3rd party collaboration and this usually requires a financial investment. Storing image data in a VNA allows the customer to authorize access and sharing privileges at their discretion.

It is clear that customers are placing increased importance on the need to own, access, and share medical image data. The Clinical Imaging Continuum model outlines the lifecycle of image data

throughout an enterprise, including key milestones where image data should be owned, accessed, and shared within a healthcare enterprise.

What is the Clinical Imaging Continuum?

Globally, across filmless imaging organizations today, common workflow trends exist. Organizations have solutions that provide the ability to:

- Order procedures
- Perform procedures on modalities where images are digitally acquired
- Diagnose images on PACS workstations
- Finalize diagnosis within reports
- Archive images for historical record and future comparison
- Image-enable the electronic medical record
- Retrieve images from the archive for new study comparison and/or clinical research
- Acquire and review images on mobile devices

These are all steps within the Clinical Imaging Continuum. In digging deeper into these steps, it becomes clear that many systems are involved in executing across this continuum. Departmental information systems are generally managing the order and results, modalities are used for performing procedures and acquiring images, disparate departmental PACS systems are used for diagnosis, the long-term image archives store image data for historical record and future comparison, and the electronic medical record presents a consolidated view of a patient's medical history — including the presentation of image data.

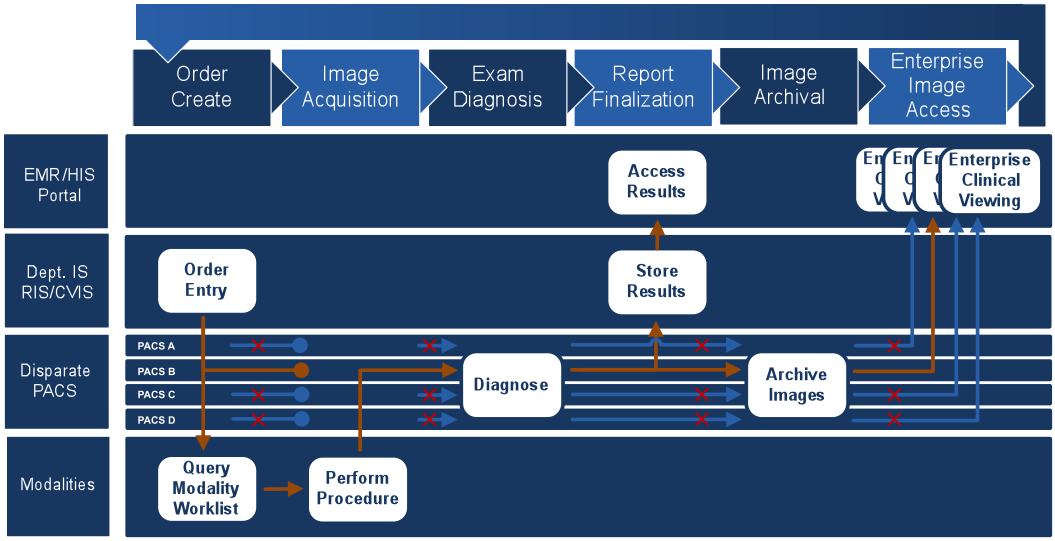

Figure 1

Figure 1 is a representation of The Clinical Imaging Continuum. The model highlights the lifecycle of image data that should be owned by an enterprise. Ownership of image data enables enhanced sharing and simplified access within (and outside of) a healthcare enterprise. Each step within the Clinical Imaging Continuum represents a significant milestone within an institution's clinical imaging workflow and, as such, has a direct role in the effective management of imaging data.

Challenges across the Clinical Imaging Continuum

Effectively implementing the Clinical Imaging Continuum in any organization across disparate PACS is challenging.

Most PACS vendors have only recently begun to provide common solutions to share images across radiology and cardiology departmental PACS. In slightly more advanced PACS solutions, a single PACS vendor may be capable of providing the ability to prefetch images from other sites and departments running the same vendor's PACS solution. More advanced PACS may also provide routing logic. All of these solutions, however, are often limited to a single vendor solution or fail to provide the ability to properly transform and translate DICOM attributes from one PACS vendor to another. Without this key feature, images often cannot be auto-associated to the correct patient or exam as a result of patient identification and accession number conflicts. In addition, presentation state and annotations are often lost, and hanging protocols may not effectively present relevant priors.

Enabling an organization to own their imaging data is a challenge. Across disparate PACS solutions, the long-term archives are also most often maintained disparately. IT storage infrastructures are duplicated and when one of the PACS solutions is retired, complex and expensive migration efforts are required. And if enterprises wish to carry forward the presentation state and annotations that are often stored in proprietary PACS vendor formats, further custom solutions and third-party professional services are required.

Enabling a simplified mechanism for accessing imaging data on an HIS, EMR, physician's portal, patient portal and beyond is yet another challenge with disparate PACS solutions. Are separate web enabled viewers provided for each PACS solution or do you require all images to be routed to a single viewing solution? Again, if a single solution is leveraged, how do users manage the DICOM transformations and translations?

Figure 2 below highlights some of the basic challenges that organizations face across the Clinical Imaging Continuum.

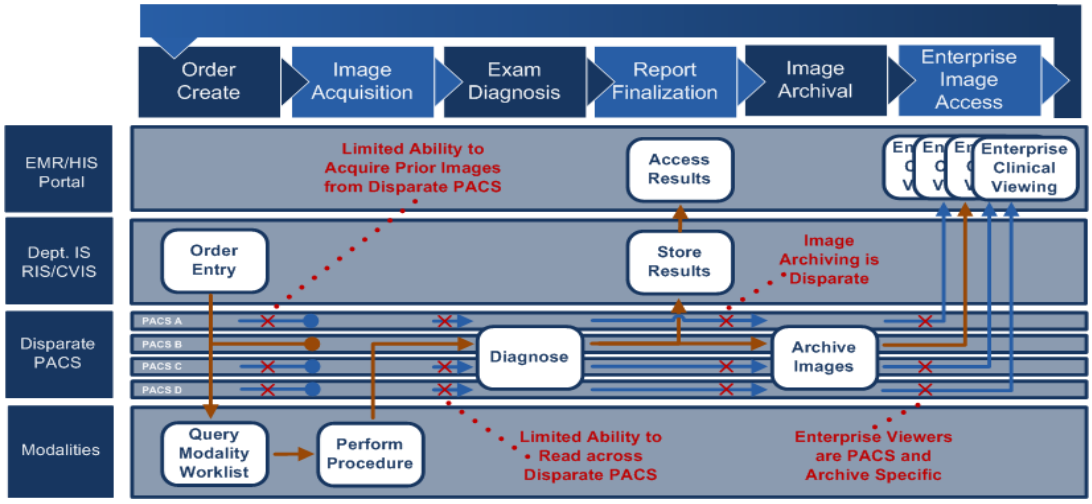

Figure 2

Implementing the Clinical Imaging Continuum

Reiterating the goal of the Clinical Imaging Continuum, how can an organization take ownership of their imaging data so that they are able to enhance sharing and simply access across the enterprise, RHIO, or national health system?

Driven by this market requirement, innovative companies have emerged with sophisticated toolsets focused on solving the challenges across the Clinical Imaging Continuum. Interoperability can be enabled across disparate PACS by taking ownership and simplifying access to image data with a PACS-Neutral or Vendor-Neutral Archive (VNA) and a web-enabled clinical viewer. Additionally, advanced image routing and prefetching with DICOM normalization capabilities can enable sharing of images across disparate PACS systems with the use of an advanced routing engine.

With a focus on the Clinical Imaging Continuum, sharing may be enabled by prefetching images from one PACS to another at the time of order creation. Intelligent routing further enables image sharing across PACS by ensuring images are sent to the most appropriate PACS at the time of image acquisition. Further, diagnosis can now be performed across disparate PACS. And, throughout all of these elements of sharing, images may be normalized to ensure they are associated to the correct patient and effectively associated within the receiving PACS so that hanging protocols may be leveraged.

During image archival, images may be archived on a VNA, thereby providing ownership of imaging data. IT storage infrastructure can be consolidated and image migration requires no more than installing the new PACS and pitching data from the VNA.

Lastly, in conjunction with the availability of a VNA, image access is greatly simplified. By providing a web-enabled, zero-footprint, clinical viewer to launch images from the VNA, viewing images from the

EMR, HIS, physicians' portal, patient portal, and beyond has been simplified to a single, secure, web URL integration.

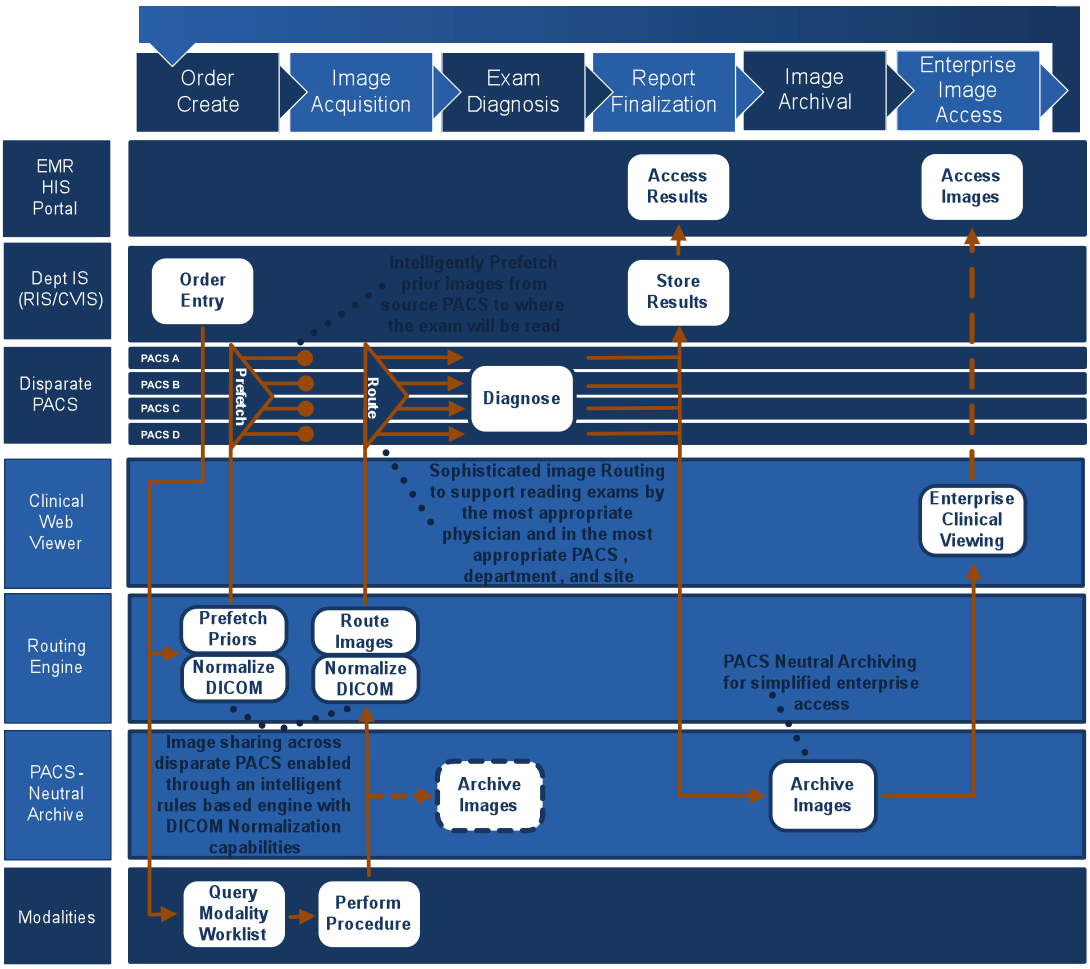

Figure 3

Figure 3 provides a depiction of a solution to effectively implement the Clinical Imaging Continuum. A summary of the key features, their role within the Clinical Imaging Continuum, and their impact on the Clinical Imaging Continuum is provided below.

- **Prefetch** – During order creation, intelligent routing engines share a patient's historical imaging procedures across disparate PACS for the purposes of comparison.
- **Routing** – During image acquisition, intelligent routing engines share acquired images across disparate PACS based on defined rules. Routing images based on off-hour support, the location of specialists, the type of procedure, and more can be enabled.
- **DICOM Normalize** – When image data is being shared across disparate PACS at the time of image acquisition or due to routing and prefetch logic, systems transform DICOM attributes.

More advanced systems compress image formats, convert transfer syntaxes, and perform specialized conversions of vendor proprietary PACS presentation state and annotations.

- **PACS-Neutral Archive** – During image archival, a VNA solution provides ownership to an organization by centralizing the archival of images to a single VNA location. With a VNA, users simplify enterprise access and enhance current PACS investments by providing the capability for any PACS to "see" across the enterprise.
- **Image Enablement** – To enable enterprise image access of the referring community, the patient portal and/or the electronic medical record, a web-enabled clinical universal viewer along with the VNA can provide a simplified approach to image-enabling the healthcare enterprise.

These important features provide the necessary functionality that result in greater image data ownership, access, and sharing across an enterprise, RHIO or national health system. They enhance the Clinical Imaging Continuum increasing clinical efficacy and improving patient care.

For more information about Vendor-neutral archives (VNA), see our whitepaper entitled: Achieving a Vendor-Neutral Archive (VNA).