

Medical Imaging Data Orchestration

The Challenges and Science of Enterprise Imaging

- Jef Williams – Paragon Consulting Partners, LLC.

Overview

Medical Imaging is a growing concern in every healthcare enterprise. Whether the challenges are presented locally within a department or globally across the enterprise, organizations are faced with resolving issues to improve outcomes, grant better access to patient information, and optimize the clinical experience. For years the focus of healthcare has been the adoption of the Electronic Health Record (EHR), and now that most have completed some level of adoption, the need to provide imaging to complete the EHR has reentered the focus of many executives and clinical leaders. This new model for imaging, however, is much more complex than implementing a PACS. Understanding the problems, developing detailed use cases, and ultimately deploying an effective solution will require image Data Orchestration that can mitigate deficiencies in the existing infrastructure.

Historically, imaging solutions provided by vendors served as the single platform and toolset to manage imaging generated by modalities. The use cases for Radiology (and subsequently Cardiology) are tightly defined and the workflow adopted to accommodate digital imaging was clearly defined within the department and was largely indistinguishable across organizations. As such, vendors were able to build a strong framework to ingest, archive, and present images to physicians for the purpose of diagnosis and clinical review. Today images are

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generated across the enterprise and in many cases, reside in disparate systems. In addition, the need to access data and define relevance is becoming more nuanced. Finding a single solution that can meet every demand within an organization can be either too costly to

replace existing systems, too disruptive to the organization, or too difficult to deploy. This has led to a growth in Enterprise Imaging solutions that

provide tools to remediate issues and optimize workflow for medical imaging. This approach is what has been defined as **Data Orchestration**, using technology to manage data to support an optimized imaging workflow environment that elevates quality care and outcomes.

Problem Statements and Data Management

To effectively design and deploy a successful Enterprise Imaging solution, it is important to begin by defining **Problem Statements**: a concise, yet complete, narrative that frames the current gaps and issues as well as provides the preferred outcomes of an initiative. These statements will include clinical, technical, infrastructural, organizational, and operational challenges that are either prohibiting or inhibiting the goals of better performance. Casting a wide net across the enterprise, most organizations can build a long list of Problem Statements; so, it is important that, via Governance, the list is prioritized based on the critical needs of the business.

At the core of many prioritized Problem Statements lies Data Management or Orchestration. This can include accessing, archiving, routing, normalizing, and migrating image data. There is an important inventory required: one must build an accurate set of Problem Statements for how data should be managed within an enterprise. There is rarely a single designation for how data is managed, as it is often defined by department, time of day, source system, and other workflow requirements, so having a complete set of workflow tools that provide true user **control** of the data is critical to the success of data management activities.

Define Use Cases

Effective Problem Statements will result in detailed **Use Cases**. By defining how the data will be managed, organizations can assess the current environment and determine how to best engineer solutions to meet the demands as defined. There are specific needs and priorities determined at the departmental and enterprise levels that introduce tension between the two. This tension is

exacerbated by the continual disruption of Mergers and Acquisitions, policy changes, and reimbursement uncertainty. But competing departmental and enterprise goals and requirements can often be mitigated with the deployment of image orchestration solutions that account for the needs of each group. Healthcare is not static; having control of data and the capability of deploying solutions that achieve the goals of both the department and the enterprise is the difference between top performing solutions and nominally effective ones.

Departmental Image Orchestration

Departmental workflow is in constant flux. New modalities, source systems, and diagnostic changes require flexibility in how image data is managed and accessed at the point of care. The challenges faced in ensuring that Radiologists are aware of, can see, and can manipulate all available relevant images when reading new studies are often insurmountable with large-scale enterprise solutions. Use cases for agile image management can be identified because of the existence of sub-specialty reading, legacy data archives, disparate PACS, and outside studies.

Image Routing

Radiologists want access to all relevant priors. The hurdles of achieving this access include: images that reside in disparate systems, ongoing migrations that haven't completed, and ingestion of outside studies. A solid Enterprise Imaging strategy that accommodates departmental workflow will include image orchestration that allows for appropriate **granularity** in designing and supporting the routing of data in a way that only relevant patient images are available at diagnosis. This includes capabilities to query and retrieve data across multiple companies, locations, or systems, even when the reading system, or target location for the relevant

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exams, is unaware of the images within those other systems. Many systems are incapable of querying beyond what is already known, which can limit access to relevant data.

Image Orchestration provides a robust and complete span of all potential source locations for relevant data that is critical to optimal patient care.

Routing of image data must include enough granularity that it accommodates any type of reading workflow. It should be **configurable** to sub-specialty, exam type, system location, and any other pertinent criteria to ensure that image movement is not generating an inappropriate amount of transactional overhead or network traffic. Intelligence within the workflow toolset must allow for users to build routing

rules that improve data management and image access, otherwise the technology is only working harder, not smarter. Helen S. Sandven, Medical Director of Breast Imaging at **Asheville Radiology Associates** states, "We have a very busy breast imaging program that requires interpretation of images from multiple systems. We need to be able to have comparison images available quickly and reliably." When their primary platform could not accommodate this dynamic workflow, they adopted the necessary toolset that allowed them to create an automated Data Orchestration model that improved efficiency and quality. "[These tools] solved this problem allowing us to spend our time interpreting images rather than retrieving them," she stated.

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Once studies are routed into the target system, these images must be presentable to the physician or specialist. Images can originate from disparate archives or from outside sources via Image Exchange, CD import, or direct transfer. Ingestion of these objects often requires some level of data normalization that may include updating patient information or normalizing private tags within the DICOM metadata. Tools that manage translations for data in motion both uni- and bi-directionally are fundamental to reliable display protocols for image objects originating from other image archives.

Pre-Fetching and Migrations

Data migration, Extraction, Translation, Loading (ETL), within imaging is constant. Some common reasons to migrate data include acquisitions, consolidations, PACS replacement, and Vendor Neutral Archive (VNA) implementations. Image data migrations once happened only during large-scale system upgrades or implementations. Today most medium to large organizations are finding it necessary to continually migrate data for standardization of infrastructure and improved access to all patient images.

Data Orchestration when managing ongoing migrations must allow for accessing, fetching, and migration of not-yet-migrated images in real time to enable current workflow requirements. In many cases new systems can "go-live" while historical data continues to stream (migrate) from legacy archives into the new environment. Building a data model using intelligent tools enables workflow by querying data not-yet-migrated and moving it into the reading environment based on triggering events. DICOM alone cannot meet this demand; so, integrating HL7 order messaging as part of the planned design for pre-fetching, along with a migration tool that provides the needed functionality is a superior model for mitigating unmigrated objects during a system migration.



Avera Heart Hospital addressed this specific need to ingest studies that were deemed relevant yet existed outside the reading environment. By implementing a workflow toolset that allowed it to create triggers associated with exams

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that appeared on the system's DICOM Modality Worklist (DMWL), these triggers allowed them to Query Retrieve (QR) associated patient exams from disparate systems that were then available as relevant priors at the point

of diagnosis. Without this functionality, Avera had to rely on manual data movement that was both inefficient and costly. "Not only does this migration on-demand strategy enable us to present our clinical team with the only studies they need to care for their patients," Dan Marnach, Avera Heart's Director of Technology said, "but it also eliminates financial waste and improves clinician productivity."

Enterprise Image Orchestration

While Enterprise image management faces a different set of challenges, they are no less important than those faced within the department. Enterprise Imaging has gained significant traction within healthcare as a component of implementing a complete EHR. The goal of providing a complete patient record to clinicians has become a primary objective for healthcare systems, introducing new constraints and obstacles that must be addressed. These obstacles include deficiencies in infrastructure, geography, systems compatibility, and data relevance. Where many vendors have addressed the ability to support an enterprise archive and image repository, there remain some critical functions that require flexible and robust tools to facilitate the on-going configuration and management of Data Orchestration for the enterprise.

Connecting the Enterprise

Image objects are difficult to manage at the enterprise level. They are large and getting larger which presents issues related to network latency – especially when sites are distributed across a large geographic region. Moving images across a Wide Area Network (WAN) is difficult and will often result in incomplete image transfers and archive exceptions within the enterprise platform. In addition, it is critical to ensure data in motion is secure for both security and compliance reasons. This data handling can include remote site image capture, telemedicine and teleradiology, large distributed Integrated Delivery Networks (IDN), as well as Centers of Excellence. In each of these instances there is a need to generate image data in one location while accessing it elsewhere. Having the

capability to support this Data Orchestration use case is what differentiates an optimal workflow.

Ideally, data should only move as required and when it moves it should be managed securely and intelligently. Utilizing local computing that accommodates DICOM and can also manage transfer protocols supporting HIPAA audit logging, and ultimately Transport Layer Security (TLS), will best achieve an enterprise imaging model. This includes mitigating network latency challenges, as well as preparing for the continued growth in the size of image objects as modalities become more sophisticated and new technologies, such as Digital Pathology and 3D Breast Tomography, become more widely adopted.

Study Data Normalization

Integrating systems across an enterprise is difficult despite the adoption of the DICOM standard. Vendors have utilized proprietary and private DICOM tags as ways to "lock" their data and make it more difficult to share. Providers have only loosely followed nomenclature standards when creating codes and descriptions (and these are changed as each new modality is integrated). Access to and visualization of image data will regularly require some level of normalization – whether it is updating patient information, modifying DICOM tags, or standardizing procedure codes and descriptions. A robust DICOM workflow toolset will provide the capability to create rules based on any data element and the ability to map data for the purpose of normalization. In many cases data moves bidirectionally between disparate systems and thus the best model will provide normalization bidirectionally; that is, to allow normalization updates to be reverted when returning data to the source system.

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Parsing DICOM is critical to successful viewing of historical image data acquired by other systems. **Quantum Radiology** is a nationally recognized subspecialty radiology practice in Marietta, Georgia that has implemented Data Orchestration tools. Ingesting data from multiple disparate PACS within their reading environment required an automated orchestration toolset that extended their existing platform. By implementing a solution that was built on a strong DICOM toolset, they are successfully ingesting objects from a large population of systems for the purpose of viewing. "It is critical that we are able to address inconsistencies in DICOM implementations and ensure the unique identification of studies coming into our PACS from different providers," states Steve Guthman, Director of IT.

Data Migration & Consolidation

The growth of system consolidation and replacement is driving demand for image migration in the Enterprise Imaging strategy. Migration tools that allow for users to design and manage internal migrations from specialty, legacy,

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and acquired PACS systems is a cost-conservative approach that is both strategic and sustainable. Any effort to migrate information requires tools that can parse private tags, remediate inconsistent DICOM data, map translations, and provide validation of data moved. The difficulty of many consolidation driven

migrations lies in the ability to support source data deficiencies. As many legacy vendors chose to manipulate the DICOM data, it is fundamental that the tools used in a migration are built on a strong DICOM library and provide a set of user functions that will support a methodology that strengthens, rather than weakens, the legacy data as it passes into the new enterprise platform. Data integrity is built on transparency and validation; the migration and workflow tools to support this effort should provide the technology mechanisms that both enable and confirm the quality of every migration effort.

About the Author

Jef Williams is Managing Partner at **Paragon Consulting Partners LLC**, he leads the several service lines including Advisory, Strategy, and Enterprise Imaging. His background as a leader at GE, COO at Ascendian Consulting, combined with 16 years of Healthcare IT experience provides him a diverse and creative approach to problem-solving and solution design. He specializes assisting organizations with organizational strategy, operational improvement, software design and selection, and enterprise deployment initiatives.

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About Laurel Bridge Software

Laurel Bridge Software provides enterprise imaging workflow solutions that solve complex, mission-critical imaging workflows that often arise when multiple business entities and their disparate clinical imaging systems must be unified. Our solutions reliably ensure new and historical DICOM imaging studies, HL7 messages, and non-DICOM objects are available to the clinical staff, at the point-of-care.

Laurel Bridge's imaging workflow solutions are implemented at thousands of healthcare facilities, teleradiology service providers, and radiology group practices in more than 35 countries, directly and through integration partners.

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Conclusion

Data Orchestration is at the core of every effective imaging model. Whether implementing a new system, upgrading and expanding an existing system, or investing to optimize one's current environment, providers must address the deficiencies that often exist with image workflow management.

There are reliable, robust, secure, and cost-effective tools available to ensure one is able to route, normalize, ingest, and manage image data to support dynamic reading workflows. Choosing an image orchestration solution **that doesn't merely architect a workaround, but truly engineers a solution** requires a careful examination of use cases and ultimately the quality and functionality of the underlying technology of the needed tools. An in-depth review of the underlying technical competency ("the science") of the vendor providing these tools will ensure one is deploying a solution that is robust, scalable, usable, and reliable. Armed with this information, one can expect to alleviate issues and optimize deficiencies within an Enterprise or Departmental imaging workflow. This is **Data Orchestration**.

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Steve Guthman
Director of IT
Quantum Radiology