A Real-World Solution for Patient-Centric Workflow

Workflow Evolution Driving New Archiving Solutions

Reducing healthcare costs, improving clinical quality and adopting a more patient-centric view are now universal goals that require ubiquitous access to clinical information. The need to integrate and consolidate information from disparate clinical systems is driving a shift towards enterprise IT solutions, such as systems-neutral storage, enterprise workflow solutions and universal viewers. Healthcare system leaders know that clinical information management and access are pervasive challenges, and that departmental systems are typically not designed to address complex workflow issues. Conversely, enterprise systems often do not support the unique needs of every clinical department. Departmental and enterprise workflow needs must be satisfied in an organized manner, to minimize IT complexity and cost. This requires IT and clinical departments to develop an enterprise imaging strategy that articulates the institution's evolving clinical workflow needs.

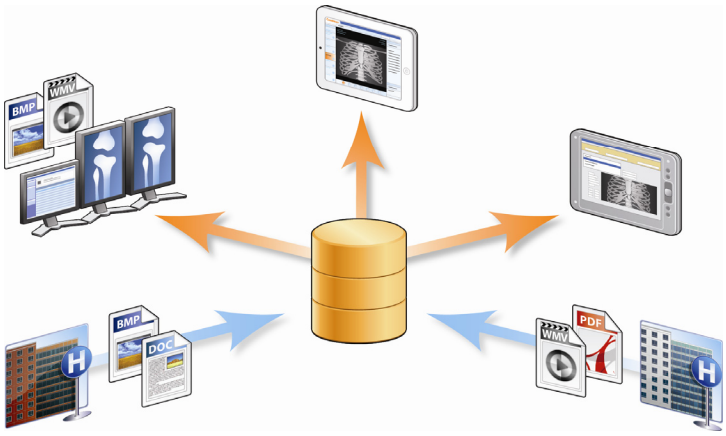
Much has been written about developments in enterprise storage, workflow and display solutions, often creating confusion about capabilities and terminology. This document attempts to provide clarity by emphasizing the operational and workflow capabilities expected of a Vendor Neutral Archive (VNA). Examples from across the globe of institutions successfully solving their critical workflow challenges will be presented. This approach is intended to enhance readers' understanding of the challenges that may be encountered when solving current enterprise workflow limitations and provide insights that might smooth the process.

Operational Capabilities Supporting Workflow Needs

The term Vendor Neutral Archive (VNA) commonly refers to an enterprise storage and workflow solution that embraces neutrality to resolve a range of enterprise workflow challenges. Understanding supported workflows and operational capabilities is critical as there is no lexicon of IT system terms. Only with this understanding can an institution determine how a specific solution will address their needs. Compounding this is the reality that no single clinical IT solution will solve a workflow problem on its own. Any VNA must work seamlessly with an enterprise workflow engine, universal viewing system and existing clinical systems.

Enterprise storage solutions must integrate, and strictly adhere to, numerous open standards to enable complex information-sharing workflows and management of clinical information. Additionally, a VNA should uniquely support enterprise interoperability – so while consolidating data, it also supports the individual needs of departmental archiving and workflow. For example, departmental archives are often optimized for reading workflow performance by incorporating a customized DICOM syntax that does not support the neutrality needed to resolve existing enterprise workflow limitations. This is the framework by which the following capabilities should be considered.

The Concept of Neutrality



Neutrality: The VNA must handle information in non-proprietary formats, regardless of the data source

The concept of neutrality is central to a VNA. These systems must comply with enterprise workflows standards by storing information in non-proprietary, interchange formats. This is the essence of "neutrality." While seemingly elementary, this concept differentiates a VNA from the typical departmental archive running a DICOM implementation optimized by the

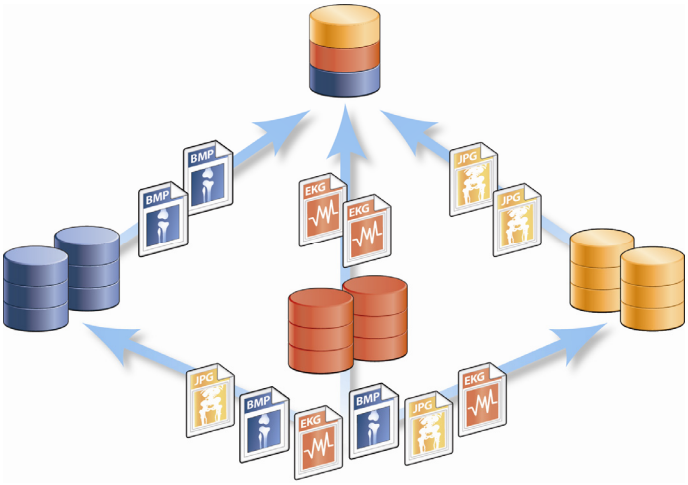
vendor to address departmental workflow – often to the extent that it is proprietary. The enterprise workflow challenge is to prioritize neutrality in favor of context and data management, simplified migration and ready access to disparate patient information, regardless of source. This requires storage and sharing of DICOM and non-DICOM data (as most clinical information is non-DICOM), text-based information, scanned PDF documents and JPEG images. Support for the IHE standards XDS/XDS-I is also required to enable complex information-sharing workflow across data repositories and data types (DICOM and non-DICOM). Even if initial plans call for DICOM-only storage, neutral systems must be in place to support XDS/XDS-I when the organization is ready to execute the next phase of the plan.

Data Consolidation and Migration

Organizations must acknowledge that clinical information consolidation and migration can be an ongoing process, but one that benefits from software and hardware neutrality. Evolving business and vendor relationships, as well as new system implementations, may require data migrations across heterogeneous vendor systems. An enterprise-imaging strategic plan should acknowledge this reality and balance the (sometimes conflicting) demands of clinical workflow and data consolidation. The ability to migrate the descriptive DICOM image header information (metadata) independent from DICOM image pixel data (actual image) should be sought. This capability enables rapid data migration without clinical disruption, even when migrating large data volumes on low-bandwidth networks. This approach has the added benefit of enabling a facility to maintain a legacy archive to manage historical information until a new storage solution can be procured.

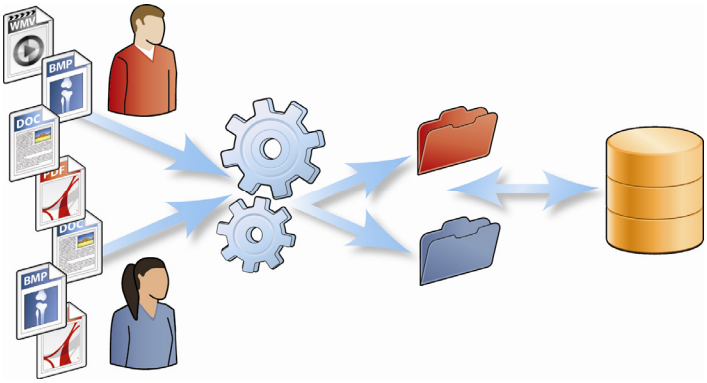
Data consolidation also requires mechanisms to ensure data integrity and synchronization – both necessary to support development of global worklists. This is particularly important as information often originates from multiple healthcare facilities and clinical systems with non-uniform methods of patient identification and DICOM conformance. Synchronizing incoming (DICOM and non-DICOM) images, reports, faxes, lab results, notes, etc., from a given patient is critical to ensure clinicians obtain a unified view of the patient's available information. Powerful metadata manipulation techniques, such as PIX, MPI and DICOM Tag Morphing, enable this capability, whether searching via Medical Record Number, Accession Number, Government ID or a patient demographic field (e.g. name, DOB, SSN).

Data synchronization also enables a multi-VNA installation to provide geographically dispersed disaster recovery and business continuity. In large, geographically dispersed implementations, such as national or regional health systems, synchronization ensures caregivers can access important clinical information, even if one system is unavailable.



Information Lifecycle Management

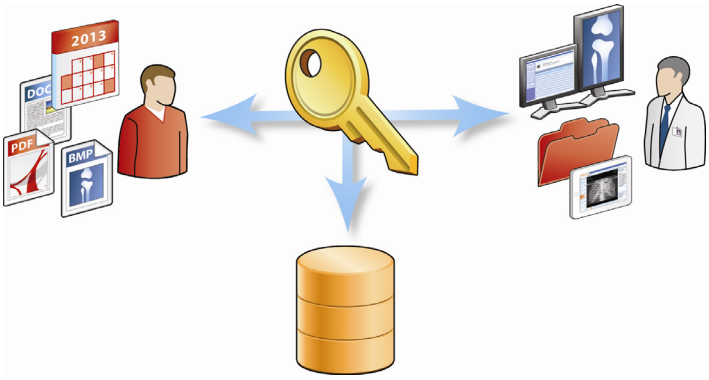
When a unified view of clinical information is realized, and information is consolidated, sophisticated protected healthcare information (PHI) retention policies can be supported. A unified approach to clinical information management enables an institution to balance escalating storage demands with clinical and legal retention requirements. Information Lifecycle Management (ILM) of clinical data stored on a VNA is a powerful tool for managing PHI retention policies. With information centralized, ILM rules can be applied more uniformly and easily managed from a location. This can cut data-management costs by reducing the FTE needed to manage the large amounts of data and by leveraging the automated rules common to ILM solutions.



IT Simplification and Consolidation

IT departments developing simplification and consolidation strategies should consider how a VNA can reduce costs and demands upon system administration while resolving enterprise clinical workflow challenges. Consolidation of existing clinical storage systems through virtualization and elimination of multiple online/offline tiers should also be possible. This simplifies future storage expansion and facilitates disaster recovery and business-continuity solutions. System consolidation and simplification also create opportunities to move infrastructure to the cloud, as many VNA providers offer managed services that operationalize all aspects of system-related expense. This can provide significant cost savings and management benefits, particularly when financial, site and IT support challenges might otherwise limit an institution's ability to meet its goals.

The productivity and clinical quality improvements enabled by storage and workflow consolidation are enhanced when they include clinical viewing consolidation. Implementing a zero-footprint universal viewer with expanded standards support, sophisticated workflow, display and security tools is an important link to improving enterprise imaging workflow. Access to heterogeneous information via a unified global worklist or image-enabled EMR/EHR requires sophisticated "neutral" viewing capability. In addition, the demands on IT to support hardware and software for a large clinical user base can be significantly reduced by leveraging this new technology.



Real-world Workflow Examples

Developing an enterprise imaging strategic plan that clarifies the workflow challenges to be resolved should precede any enterprise technology assessment. This is important because of the many constituents involved, range of technologies impacted and need to clearly articulate priorities. Approaching a VNA implementation incrementally can also increase the likelihood for success by resolving workflow challenges in a logical and step-wise fashion. To this end, understanding others' experiences can help identify viable approaches an organization may wish to follow. The following real-world scenarios illustrate how a VNA, and a carefully considered enterprise imaging plan, can simultaneously address these (and other) enterprise imaging challenges:

- Unmanageable IT support costs because of the large number of disparate IT systems
- Clinical users unable to get a unified view of patient clinical information across disparate systems
- Poor system availability with inadequate business continuity and disaster recovery
- Slow data migration, often interrupting clinical service

A Large Urban Integrated Health Network Realizes Productivity from a Unified Worklist

ROCHESTER GENERAL HEALTH SYSTEM

When Rochester General Health System was planning updates to their older multi-site, multi-archive distributed PACS, the IT department recognized an opportunity to implement an enterprise architecture across their eight clinically integrated affiliates. The IT department identified unnecessary redundancy across multiple departmental archives, including network demands and additional maintenance and support costs. Current clinical workflow needs were being minimally addressed, but were not sufficient to support the organization's evolving needs and growing imaging volumes. The IT department implemented a best-of-breed solution by leveraging existing relationships with their IT hardware and virtual machine (VM) vendor. A single, unified Rad/Card PACS was implemented, with a virtualized Vendor Neutral Archive providing long-term online storage for 230,000 studies annually, from two hospitals and four outpatient imaging facilities. The VNA implementation accommodates future plans to store non-DICOM clinical information in addition to the

current DICOM image data. Operational and cost benefits for the IT and support departments also enabled reallocation of resources to other projects.

Consolidation of the Rochester Health System infrastructure occurred in conjunction with an assessment of enterprise clinical viewing needs across the enterprise. Clinical viewing consolidation was achieved using a zero-download viewer for enhanced access to the information stored on the VNA. This unified approach also leveraged other enterprise security measures, such as LDAP, which were already in place. Clinical information on the VNA is also available for viewing via the system-wide Electronic Medical Record (EMR), so clinicians' decision-making and productivity benefit from ready access to required clinical-imaging information. Clinicians can also access key images, reports or the entire imaging study, from a single, familiar clinical viewer, enabling faster responses to clinical needs and greater focus on delivering high-quality care. Chuck O'Brien, RIS/PACS Administrator at Rochester General Health Systems, reported, "Our unified approach to IT system consolidation and simplification enabled our radiologists to more quickly access historical studies on PACS, as all information is now online. Radiologist productivity, decision support and clinical learning have all benefited from easy access to historical information."

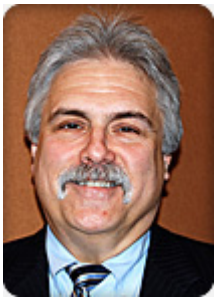
A Large, Urban, Integrated Health Network Maintains Critical Services During Transition

Because of the complexity and range of capabilities inherent in a VNA, it is able to address numerous workflow scenarios and provide many benefits. Data and hardware consolidation are merely one example. The sophisticated image manipulation tools within a VNA should be able to speed the migration process. For example, Saint John Health System, a nine-hospital, integrated health system based in Tulsa, Oklahoma, was faced with a particularly challenging situation. They wanted to replace their legacy PACS and archive and also implement an enterprise solution to consolidate information from their many facilities. Rather than perform a costly and time-consuming data migration of the existing PACS archive to a new platform, Saint John implemented a phased migration approach that leveraged the capabilities of the new platform: initially only the metadata was migrated from the legacy PACS archive, leaving the image-pixel data on the legacy archive. Image-pixel data was then migrated on an as-needed basis, when priors were requested, or after hours when bandwidth was optimal. This ensured historical information was immediately available to all users, as if it were stored on a single platform. Establishing the enterprise repository in this manner minimized the impact data migration would have had on the day-to-day operations of the existing system and enabled the health system to go live faster with the new PACS.

A Large Suburban Medical Center Seeks Cost Savings from Simplified Infrastructure

It is important to ensure both clinical and IT departments benefit from an overall shift towards an enterprise strategy. Winthrop-University Hospital in Mineola, New York, a 600-bed, community-based teaching hospital and regional trauma center performing 200,000 annual exams, was careful to ensure this was the case. When planning their PACS infrastructure upgrade, Winthrop-University Hospital determined it would be a good time to leverage the enhanced vendor neutrality (of a VNA). The goal was consolidation of data from multiple clinical departments and preparation for future hospital network expansion that would accomodate increasing clinical data access demands. They implemented a cloud-based VNA and migrated existing online and offline diagnostic and interventional radiology, radiation oncology, vascular ultrasound and cardiac CTA studies. Cardiology and Orthopedic data are now being added and include DICOM and non-DICOM studies and scanned JPEG files.

The enterprise view adopted by Winthrop-University Hospital extended to providing clinicians with "universal" workstation access. The goal was to leverage the "neutrality" of the VNA storage infrastructure and single backend interface that was no longer limited by multiple unconnected systems. Separating clinical storage from clinical viewing is expected to simplify future technology deployments by the hospital and increase the technology options available for future consideration. The IT department also rolled out new enterprise access policies that simplify deployment of new services to their large and diverse clinical user base. Importing studies from a patient-supplied CD was also centralized, to ensure all studies become a part of the permanent record managed by the VNA. This eliminated the need for radiologists to manage patient-supplied CDs and had a positive impact on radiologist productivity.



"Consolidating pockets of disconnected storage helped the Winthrop-University Hospital balance institutional storage needs, simplify creation and management of a business continuity solution, and better support facility growth through redeployment of IT resources," confirms Rick Perez, Administrative Director of Radiology at Winthrop-University Hospital.

Their cloud-based approach now provides the hospital with a redundant offsite copy of all information stored in the VNA, in addition to universal clinical access. IT has shifted focus to managing users instead of servers, improving clinical information access and physician satisfaction. Hardware deployment no longer limits information access, as login credentials and user class now define user capability and access. Winthrop-University Hospital leadership expects clinical quality improvements to shorten length of stay and support future Meaningful Use attestation. The strong relationship between the IT and clinical departments will enable future success with these efforts and ensure that new technologies support improved clinical quality and customer service.

Large Government Health Network Enables Enterprise Access

The geographic dispersion of national health networks favors centralized systems with neutral-storage architectures. Patients are often seen at different institutions, resulting in clinical information and care teams being widely dispersed. In these situations, consolidating clinical information storage and access creates significant opportunities to improve clinician workflow and quality of care. This is the case with Assistance Publique Hopitaux de Paris (AP-HP), a 47-hospital public health system in Paris, France.

AP-HP recently updated their 23 individual, multivendor PACS and consolidated storage of imaging studies into a unified solution that uses global worklists to speed access. AP-HP implemented a centralized, independent archive in their primary data center, storing 1.6M DICOM studies and reports annually. This central database provides a registry for all radiology studies performed and enables subspecialty and cross-facility global worklist development, regardless of where the images originated. Imaging studies from all facilities are available to clinical users across the AP-HP system within 10 seconds of being archived. Clinicians can view these images and reports via a zero-footprint viewer tied into the AP-HP central EMR.

Dr. Daniel Reizine, AP-HP PACS coordinator and neuroradiologist at Lariboisiere Hospital said, "By image-enabling our EMR access to clinical information at the point of care, clinical decision making and physician productivity have all benefited. As more non-DICOM/non-image-based information is stored on the central archive, we believe these benefits will extend to other clinical areas of the AP-HP system."

Large HMO Improves Patient Care Through Consolidated Architecture

A patient-centric approach drove Clalit Heath Services in Israel, the world's second largest Health Maintenance Organization, to implement a centralized storage architecture for standardized enterprise-reading and clinical-viewing workflow. Eliminating repeat exams and enhanced productivity were original goals and have been achieved. Shared worklists and an image-enabled EMR provide 10,000 physicians, across 12 hospitals and 40 imaging centers, access to 5M annual Radiology, Cardiology and Ophthalmology studies. Universal access to a complete patient record has also simplified the establishment of clinical centers of excellence, providing oversight to Israel's rural areas and speeding sequential pathology follow-up of oncology patients. The Clalit central data center is also tied to a remote disaster recovery solution.

Dr. Arnon Makori, Radiologist and Director of Imaging Informatics at Clalit Health Services, feels, "The only way to achieve increased quality of care, centered on patient needs, is to provide universal access to clinical information and eliminate independent, site-specific workflows. If the workflow is optimized, then everyone benefits: the patient, radiologist, specialty physicians and IT."

Large Private Health Network Consolidates Clinical Viewing Across Disparate Systems

As discussed earlier, IT storage consolidation and simplification are enhanced when display resources are simultaneously optimized. Spire Healthcare, a 37-hospital private healthcare system in the UK, has demonstrated that clinical viewing consolidation can bring significant productivity and clinical quality benefits – even if implemented prior to storage consolidation. Spire Healthcare needed to enable their clinicians to view patient images from any location, across a multivendor PACS environment, to satisfy physician and patient needs. Spire implemented a zero-download clinical viewer that leverages neutrality to enable viewing from mobile and stationary devices, across their multivendor PACS environment.

Stephen Hayward, IT Director at Spire Healthcare, points out, "We were aware of the importance of unifying clinical viewing to improve physician productivity and differentiate our services from those of our competitors. We constantly look at how we can use technology to provide a better service to both patients and physicians."

The new unified clinical viewing approach enables radiologists to discuss findings with offsite clinicians in real time, as both parties can simultaneously view images. "Anywhere access" also enables radiologists to rapidly provide a preliminary report from any location, providing clinicians a head start on treatment options.

As Andrew Milne, Imaging Manager at Spire Hartswood Hospital, points out, "The fact that this works across different platforms is a great advantage, as many of our physicians work at multiple sites. Our unified clinical viewing solution enables physicians to access needed information from any Spire hospital."

Strategic Planning Ensures Success

It is short-sighted to view a VNA purchase as merely an opportunity for IT hardware simplification or consolidation of radiology images. This narrow view jeopardizes the enterprise clinical workflow improvements that broadly benefit clinical quality and physician productivity. As these examples have illustrated, success is often driven by an enterprise imaging plan that reflects the organization's overall needs – and not just those of a single department. It is also reasonable to expect that one or more of the following enterprise imaging challenges can be addressed, even if primary drivers are improved patient care, physician productivity and clinical quality:

- Unmanageable IT support costs because of the large number of disparate IT systems
- Clinical users unable to get a unified view of patient clinical information across disparate systems
- Poor system availability with inadequate business continuity and disaster recovery
- Slow data migration, often interrupting clinical service

Enterprise imaging-technology assessment is clearly more complicated than assessment of departmental solutions. Due in part to a lack of common enterprise IT standards, but primarily because of the integration of multiple systems, it remains critical to consider the entire spectrum of patient care. Understanding examples and speaking with those further down the enterprise imaging path can identify needs and provide guidance beyond the technical specifications of a single component. This is particularly true because a VNA decision impacts departmental PACS architectures and radiologist, clinical and IT staff workflow. For these reasons, it is also wise to plan implementation of these solutions in phases. With a plan in hand, plus clear goals and priorities,

a successful enterprise imaging-technology assessment can occur. Because a VNA is only a single gear in an enterprise workflow machine, understanding the big picture is more important than comparing the specifications of the overall solution's individual elements.

Dictionary of Key Terms

PIX – Patient Identifier Cross Referencing. An IHE standard mechanism for reconciling patient demographic information across disparate clinical systems.

MPI – Master Patient Index. The ability to associate patient data from different clinical systems that support different patient identification schemes.

DICOM Tag Morphing – The ability to modify the DICOM header (metadata) of an image to facilitate exchange across IT systems with different DICOM conformance.

XDS/XDS-I – Cross Enterprise Document Sharing for Imaging. An IHE standard profile that enables sharing of non-DICOM (i.e. JPEG images, scanned documents, text-based documents) information across disparate healthcare systems.

Metadata – Refers to the DICOM header information that describes the actual image (pixel) data (i.e. demographic data, study parameters).

Pixeldata – Refers to the actual DICOM image pixel data that constitutes the medical image.