WHITE PAPER

# Top Ten Criteria

## for Evaluating and Selecting an Enterprise Medical Imaging Repository

### A Checklist for Healthcare Organizations


AGFA HealthCare

## Introduction

Physicians depend on medical imaging as a tool to help diagnose rapidly and treat diseases effectively, which results in enhanced delivery of patient care and a more efficient and cost-effective healthcare system. As digital technologies make medical images easier and faster to obtain, access, read and store, the importance of imaging to healthcare and disease management continues to increase.

The prevalence of medical imaging extends far beyond the radiology department. Patient images and associated data are generated in cardiology, surgery, dermatology, ophthalmology, gastroenterology, pathology, surgery, dentistry, nursing, and other clinical departments in various formats such as TIFF, BMP, GIF, JPEG, AVI, WMV, and MPEG. Yet this valuable clinical information is often trapped in departmental picture archiving and communication systems (PACS), "homegrown" imaging solutions, or custom image catalogs located throughout a single facility, healthcare campus, or multi-location healthcare network. These departmental imaging solutions may or may not conform to Health Insurance Portability and Accountability Act (HIPAA) or organizational information management requirements. Patient imaging information may be inaccessible outside the department or even discarded after acquisition and initial use, regardless of potential future value. To improve the quality and efficiency of patient care, healthcare organizations need a cost-effective strategy for managing an ever-increasing volume and diversity of medical imaging data.

This challenge can be addressed today by extending the concept of the electronic health record (EHR) to include support for all medical images and related information, which would provide physicians with point-of-care access to consolidated imaging data, regardless of department origin. Using standards-based interfaces and imaging solutions, specialists and diagnosticians are able to retrieve, view, and manipulate images. Effective use of imaging studies by the broader medical community of clinicians, referring physicians, and remote specialists requires a clinical imaging viewer that extends access from the imaging component of the EHR to wherever healthcare is practiced.

By deploying a large-scale longitudinal repository of clinical imaging data, hospital groups, regional healthcare information organizations, or even national healthcare systems can build a foundation for accessing the complete electronic medical imaging record, an investment that allows a single point of integration to image-enable an existing EHR application or physician web portal. An additional benefit of a consolidated image repository is the reduction or even elimination of the cost of maintaining multiple departmental image archives as well as the expensive and time-consuming data migrations associated with periodic PACS replacement.

A number of commercial enterprise image archive and management solutions are available to healthcare organizations. The purpose of this white paper is to identify and describe the ten key selection criteria we believe are necessary for evaluating and selecting a solution:

1. PACS Vendor Neutrality
2. Standards-based
3. Supports Multiple Imaging Departments
4. Storage Vendor Neutrality
5. Enterprise Clinical Visualization
6. Support for Multiple Patient ID Domains
7. High Availability Configurations
8. Disaster Recovery and Business Continuance
9. Massive and Incremental Scalability
10. Information Lifecycle Management

By using the criteria presented in this paper when evaluating vendors and product offerings, IT departments can select a medical image repository successfully meets the technical, business, and financial requirements of today's healthcare organization.

## 1 PACS Vendor Neutrality

Enterprise information systems, such as the hospital information system (HIS), radiology information system (RIS), PACS, and EHR, must be integrated to share data and enable efficient workflows that span multiple hospital users and systems. A number of integration challenges exist in the hospital enterprise.

Traditionally, each PACS solution included a built-in image archive that served its departmental users well, but was not designed to meet the needs of the larger healthcare organization. The result has been department-driven imaging system purchases and a proliferation of independent, vendor-specific image archives. Unable to effectively share information, these separate "information silos" are a major barrier to sharing longitudinal data and enabling efficient enterprise-level workflows. This is most obvious when examining the data migration challenges of existing PACS, which were clearly not designed to provide scalable, high performance support for anyone but the local system users.

One of the greatest challenges in choosing an enterprise image archive is finding a solution that is interoperable with multiple products and vendors, which would enable clinician access to all relevant imaging data, regardless of source. A truly vendor-neutral archive solution is able to integrate with existing PACS environments from many vendors and can also be relied upon to integrate with imaging or information systems acquired in the future.

PACS vendor neutrality, which enables true interoperability in a heterogeneous environment, can only be achieved by adopting an image archiving and visualization infrastructure that embraces industry standards. Many in the healthcare industry continually work to evolve and facilitate use of common languages. Standards-based solutions are by nature collaborative, and have been designed to interoperate with other standards-based systems.

## 2 Standards-based

The most important industry standard for medical imaging is Digital Imaging and Communications in Medicine (DICOM), a protocol that enables the exchange of medical imaging information between image acquisition modalities, diagnostic PACS, specialized image processing applications, and clinical viewers. Another important standard is Health Level 7 (HL7), which enables non-imaging communications between both imaging and information systems such as the HIS, RIS, and EHR.

Almost all PACS vendors can claim a minimal degree of DICOM compliance; yet integrating systems and seamlessly sharing data within a clinically acceptable workflow remains a challenge. Vendors readily offer "DICOM Conformance Statements" as evidence of standards compliance, but this alone is an insufficient guarantee of meaningful interoperability – even for DICOM integration experts.

Why? The DICOM and HL7 standards rigidly define the structure of system messages; loosely define the message content; and never define the relationship between the message content and the clinical workflows supported by the message. This leaves much room for vendor interpretation of an ever-evolving standard. The result is that turnkey interoperability, even with well-adopted standards such as DICOM and HL7, has remained elusive.

Many vendors and industry organizations, such as the Radiological Society of North America (RSNA) and the Healthcare Information and Management Systems Society (HIMSS), recognized the strengths and limitations of existing standards. In response, they created Integrating the Healthcare Enterprise (IHE), an active, on-going, multi-vendor initiative that improves interoperability by specifying exactly how existing standards may be used to create accurate and predictable data workflows that support effective healthcare practices in a multi-vendor environment. When vendors invest time and resources to engineer solutions that conform to various aspects of the IHE Technical Framework, "plug-and-play" interoperability becomes possible. During the purchasing process, savvy customers require product conformance with appropriate IHE Integration Profiles, which define the workflows that resolve their specific business needs. A few straightforward requirements can prevent the wasted time, energy, and resources of struggling with integration issues and developing expensive custom integrations between different systems.

### SHARING PATIENT IMAGES ACROSS MULTIPLE ENTERPRISES WITH XDS

Growth, consolidation, and collaboration within the healthcare community have resulted in a greater need for real-time access to a patient's complete medical record, regardless of treatment location. Within a single course of treatment, a patient may visit different hospitals or clinics to have various procedures performed. Each facility has its own patient records and charts – some on paper in a file, others in an electronic format on a computer. When the patient is referred to another doctor at another institution, these files do not automatically follow.

More and more institutions are creating electronic records, but they are not always accessible to other doctors, even within the same healthcare organization. Unfettered access to patient information is critical for all physicians, but without all of a patient's different identifiers, it is almost impossible for one doctor to easily and efficiently review the entire electronic medical history.

In 2005, the IHE introduced a new profile to address these challenges. The Cross-Enterprise Document Sharing Profile (XDS) provides a solution for sharing documents across agroup of affiliated enterprises. XDS is focused on providing a standards-based specification for managing the sharing of documents among healthcare enterprises. Based on XDS, more "content-oriented" IHE Integration Profiles have been developed to address the content of the documents that need to be shared (e.g., XDS for Imaging, or XDS-I). An advantage of an XDS-enabled system is that each site can continue to leverage its current investments in radiology, cardiology, lab, etc. Even if the clinical system is not XDS-capable, there are XDS "proxy" solutions that can be added to enable the current system to participate in an XDS infrastructure. An XDS-enabled system contributes to the foundation of a shared EHR, providing facilities with a large, unified, and ubiquitous view of all patient encounters while maintaining the full autonomy on the local system.

A medical image archive should support all known DICOM data objects, which define the image type to be exchanged, and be user configurable to support new data objects. More importantly, a product's IHE Integration Statement should specify the IHE Actors (units of functionality) and IHE Integration Profiles (solutions to problems) supported by a specific version of a product.

Recommended IHE Integration Profiles for medical image archives, PACS, and enterprise clinical viewers include: Scheduled Workflow (SWF), Patient Information Reconciliation (PIR), Consistent Presentation of Images (CPI), Key Image Notes (KIN), Simple Image and Numeric Reports (SINR), Access to Radiology Information (ARI), and, in certain environments, Cross Enterprise Document Sharing (XDS).

## 3 Supports Multiple Imaging Departments

Much attention has been paid to radiology and cardiology imaging, but imaging is common as well in other clinical departments, including dermatology, ophthalmology, gastroenterology, pathology, surgery, dentistry, nursing, and other practices that use various forms of still and motion video cameras to capture and assess the patient condition or procedure.

Once images or video sequences are acquired, the data is indexed and stored in some form of image catalog. In some cases, the image data may be recorded to hardcopy (recordable CD, film, etc.) and physically filed, given to the patient, or simply discarded after acquisition and initial use. A standards-based enterprise medical image archiving system should support all departmental imaging sources in a similar manner to the proven models for radiology and cardiology, developed over decades.

Existing standards, particularly DICOM, provide the powerful ability to identify, describe, store, query, retrieve, and move imaging data in a manner that is portable across many different imaging solutions, while simultaneously promoting efficient workflows and patient safety. To take advantage of these benefits, acquired images and videos must be correctly identified, described, encapsulated or converted as necessary, and stored into a standards-accessible medical image archive. Departments that have historical experience with imaging (e.g., radiology and cardiology) understand the importance of managing the quality of imaging data as close as possible to the time of acquisition, as later correction of incomplete or inconsistent data may be difficult or impossible. This allows for the development of acquisition workflows that promote efficiency and accuracy, leveraging models like the use of clerical staff for data entry, acquisition technologists or physicians for patient interaction, image acquisition and quality control, integrated scheduling / order entry systems, and integrated acquisition devices.

A key benefit of such a solution is the ability to view this imaging data side-by-side with the same tools used to view traditional radiology or cardiology imaging studies, providing unprecedented access to any clinician. The goal across all clinical imaging departments is to improve healthcare through information sharing, increase collaboration between generalists and specialists, and enrich communication with patients by leveraging a common imaging infrastructure and best practices in a cost-effective manner.

## 4 Storage Vendor Neutrality

An enterprise medical image archive ideally uses an open systems architecture that supports a wide variety of ever-evolving archival storage devices. Such systems are called “storage vendor neutral” archives.

Most information systems are database-centric and require a modest amount of highly-available storage that performs well in the context of random database input/output (I/O). On the other hand, medical imaging systems, particularly archives, require a great deal of storage that must be cost-effective and perform adequately in the context of sequential I/O. A medical image archive must be carefully architected to meet customer expectations because it manages potentially immense quantities of quasi-fixed content medical image data on a variety of archival storage devices, each offering its own interesting combination of functionality, availability and cost.

## MEDICAL IMAGING SYSTEM OF RECORD

The medical image archive should, by design, operate as a single enterprise-wide medical imaging system of record. In order to do this, the archive must have a number of required attributes meet this significant responsibility, including massive scalability, high security, high availability, business continuance capability, native data integrity, comprehensive healthcare standards conformance, and open architecture.

As discussed, the system of record for medical images and related clinical information is usually a collection of geographically distributed departmental PACS systems and non-PACS image catalogs. By migrating existing data from these multiple departmental image repositories into an enterprise medical image archive, a single system of record for all medical images and related information can be created. From this strategy many benefits can be achieved.

Ideally, each departmental PACS relies on a single external, standards-based, enterprise image archive as the system of record as opposed to its own internal image archive. In this model each PACS maintains a cache of recent image data – as much needed to satisfy performance requirements; enable autonomous operation in the event of a temporary disconnection from the enterprise archive; and meet budgetary constraints. The need to acquire, maintain and periodically replace a separate image archive for every departmental PACS is eliminated.

In this model, an organization is no longer "locked in" to its current PACS vendor when it needs to replace a PACS and migrate data between old and new solutions. Using this strategy, a new imaging system has access to all existing enterprise imaging studies. Each imaging department chooses the imaging system that best meets its needs, without budgeting for archival storage and migration functionality.

Ideally, the medical image archive can support its own short-term tier 1 image cache, which makes a configurable amount of fast and reliable storage available, independent of the performance or availability of any tier 2 archival storage device. This is valuable because many archival storage devices reduce cost at the expense of performance, availability or complexity. Also keep in mind that some "near-line" archival storage devices may support additional tiers of storage; for example, a small amount of spinning disk and a large amount of removable media in an automated media library.

The medical image archive should be stored in a vendor-neutral file format, as defined in Part 10 of the DICOM standard, which can significantly ease data recovery in the event of disaster or product/vendor failure. Further, the image data is aggregated to reduce the total number of files or objects required to store many millions of images. This is important because most storage devices experience capacity limitations or performance degradation as file or object counts increase. In the case of file systems, data should be stored across multiple file systems in a manner that minimizes conflicts with the inherent limitations of most file systems, particularly with respect to capacity constraints or the numbers of files or directories supported.

Products and underlying storage technologies evolve over much shorter periods than the lifespan of the customer's imaging data. By architecting a

### ENTERPRISE STORAGE CONSOLIDATION

Consolidating multiple information systems onto a single enterprise storage infrastructure creates economies of scale that are appealing to IT departments. When IT departments examine the multiple imaging systems found in the enterprise, the total data storage in use, and the rate of growth, the typical reaction is to consolidate storage. Storage vendors provide large capacity storage devices capable of storing image files or image objects.

Consolidating multiple imaging systems onto a single storage infrastructure is more difficult than it seems. Several questions must be answered:

- Does each existing PACS, a U.S. Food and Drug Administration (FDA)-regulated medical device, support the IT department's preferred storage technology?
- If each PACS is located in a separate facility, is it cost-effective to network-connect each local PACS with a storage device in a remote data center, or is a separate storage device required for each facility?
- What are the costs of migrating data from existing storage to the new storage device and reconfiguring the PACS?

The most important issue in consolidating multiple PACS onto a single common storage device is that this strategy cannot as a single investment achieve clinical objectives for improving image data accessibility, data sharing, or enhanced delivery of patient care. Simply adding enterprise storage under multiple image storage applications does not promote and improve data sharing between applications and users.

A far better solution to the enterprise storage consolidation problem is to utilize a standards-based medical image archive as the "middleware" between the facility-local PACS and the IT department's preferred enterprise storage technology located at the data center. In this model, all standards-based PACS, imaging systems, and enterprise viewing platforms can access a patient's medical imaging record. This is accomplished by using the universally-accepted DICOM standard to archive, query, and retrieve medical imaging data from the enterprise medical image archive. In this manner, a healthcare facility can achieve the clinical benefits and return on investment of a centralized enterprise storage consolidation strategy.

storage vendor-neutral medical image archive, a vendor provides value that is evident as the archive grows and helps "future-proof" the healthcare facility's investment.

## 5 Enterprise Clinical Visualization

An enterprise medical image archive consolidates clinical imaging information and makes complete image data sets accessible to any imaging system that conforms to the DICOM standard to which the archive conforms. This enables the storage, query, retrieval, and effective utilization of images and related data that conform to this DICOM standard from imaging systems such as image acquisition devices, diagnostic PACS, 3D reconstruction tools, computer aided detection (CAD) software, fusion technologies, and other advances. Image consolidation has great value to diagnosticians and specialists using advanced tools and powerful workstations. In addition, the ability to share clinical imaging information across the enterprise is a tremendous benefit to clinicians who lack access to powerful workstations, network bandwidth, and advanced software but do have use of an EHR or physician web portal.

Healthcare IT departments face a multitude of deployment challenges when distributing large medical images and cross-sectional data sets to clinicians using existing workstations within and outside of the institution. This challenge is exacerbated by infrastructure limitations and environmental issues, such as aging workstation hardware (CPU, memory, monitors) and non-supported operating systems. Other complications include administratively locked down desktops, limited network bandwidth, unpredictable network latency, firewalls, VPNs, multiple Sun Java or Microsoft .NET software framework versions, security, and HIPAA privacy requirements. Even well-funded IT departments struggle with the cost of infrastructure improvements and technical support services required to deliver medical images in this environment.

An enterprise-class clinical visualization solution that has been purpose-built to work in this type of environment solves this problem. Deployment challenges can be overcome by using server-side computing, allowing the loading and processing of large images and image sets in a controlled environment at the data center and enables image viewers to run on existing workstations and across modest DSL and cable network connections. This contrasts sharply with traditional client-side computing, which requires large images and image sets to be sent across the network for processing at the workstation.

Server-side computing allows client viewing software to be securely launched into a specific patient/imaging study from directly within an EHR. For example, a functionally powerful client software application can be quickly downloaded, does not require administrative rights to install on locked-down desktops or the installation of additional software frameworks like Sun Java, Microsoft .NET, or Adobe Flash Player, and has zero data footprint on the workstation. This technology combination, yet uncommon in the marketplace, can overcome many of the technical challenges encountered when broadly deploying image visualization services.

An enterprise-class clinical visualization solution has several important features. It must provide:

- Secure and meaningful access to the longitudinal patient imaging record
- An easy-to-use interface for first-time and infrequent users, such as referring physicians
- Powerful features for specialists and remote diagnosticians who want to view and interpret imaging studies
- Support for IHE Consistent Presentation of Images (CPI) and Key Image Notes (KIN) Integration Profiles, so that for studies originating from PACS that conform to CPI/KIN, the image viewer can display not only images but standards-based markup information such as window leveling, pan, zoom, flip, rotate, annotations, regions of interest, and images of interest
- Support for the IHE Image Display Actor, which allows direct access to an enterprise image archive to source image data instead of an internal cache of image data, which reduces cost and prevents archive-viewer data synchronization issues.

## 6 Support for Multiple Patient ID Domains

Multi-site healthcare enterprises often face the challenge of managing multiple facilities that each use a distinct patient ID domain. It is common for the patient ID numbering schemes from different domains to conflict, leaving a patient's medical record inaccessible because it is fragmented across multiple patient ID domains. Well-meaning attempts to resolve this problem can result in the unmanaged co-mingling of patient data from multiple patient ID domains and lead to patient identification-related issues.

At minimum, an enterprise medical image archive must be able to store image data originating from multiple patient ID domains without conflict and serve that data back to the source systems in the originating patient ID domain. This alone does not guarantee that a clinician can easily access a longitudinal patient imaging record that may span across multiple patient ID domains. The best solution uses an enterprise medical image archive integrated with an enterprise master patient index (EMPI).

A standards-based integration between the archive and the EMPI, preferably using the IHE Patient Identity Cross-Reference Integration Profile (PIX), is an ideal solution for the healthcare system. When the archive receives a request for patient information, an IHE PIX query to the EMPI allows it to locate all of the medical images for that patient, regardless of the patient ID domain in which the images were acquired. These images can then be returned to the requester. A common challenge is that many diagnostic PACS solutions are not able to natively handle images from non-local patient ID schemes, so workarounds like patient ID prefixing may also be required. For the clinical user, an enterprise clinical viewer that is able to query, retrieve and display images across multiple patient ID domains provides the clinician with transparent access to the longitudinal patient imaging record.

## 7 High Availability Configurations

As users increase reliance on an enterprise medical image archiving and visualization infrastructure, they come quickly to depend on these services as part of the standard procedure for delivering patient care. Service disruptions are not desirable.

Solutions that utilize configurations that contain multiple single points of failure should be avoided. Because many components fail over time, the first step to improving the overall availability is to take steps to eliminate single points of failure. The most common technique is to selectively add redundancy to the solution. However, hardware redundancy alone is only part of a solution to improve availability in a system comprised of many components.

Commercial off-the-shelf components such as network load balancers and physical servers can be purchased in redundant configurations right out of the box. For storage subsystems, high availability configurations utilizing clustered network attached storage (NAS), storage area

network (SAN) heads and/or Redundant Array of Independent Disks (RAID) disk arrays can be found but require investigation to ensure that they meet an organization's availability criteria.

The toughest redundancy challenge for medical image archive and visualization solutions usually involves application and database servers. Solutions that offer network load balancing across multiple redundant, stateless application servers (deployed in an N+1 configuration) are the most simple and robust, while solutions involving "stateful" application servers are inherently more complex and consequently less robust when deployed in redundant configurations.

## 8 Disaster Recovery and Business Continuance

Even the most highly available configurations are susceptible to disruption in the event of a natural disaster such as a flood, fire, or other scenario involving multiple component failure. Depending on the solution and specific failure scenario, the consequences of a disaster may include not only a temporary or extended disruption of service, but also a temporary or permanent loss of data.

A healthcare organization must clearly identify its disaster recovery requirements up front, setting expectations that reconcile the desire for protection from potential negative business impact against the available budget and willingness to proactively address risk. This includes expected recovery point objective (RPO) and recovery time objective (RTO) if the primary data copy is damaged, destroyed, or otherwise unavailable.

It may be cost-effective to create a remote replica of the data and a complete secondary image archive located at a geographically-separated secondary data center. When combined with a second enterprise clinical visualization solution, this configuration can serve as part of an organization's business continuance strategy, because a surviving second data center can continue to offer archival services and clinical access to imaging data even after a total loss of the primary data center.

Ultimately, an enterprise-class medical image archive and visualization solution should support a wide variety of availability, disaster recovery and business continuance requirements in a number of configurations that can be tailored to meet the specific desires and budget of the healthcare organization.

## 9 Massive and Incremental Scalability

An enterprise medical image archiving and visualization solution must meet the performance needs of its users. While this is relatively easy to establish during the initial implementation, it is more difficult to determine in advance if a solution will be able to retain the same response time as it scales to meet the evolving needs of healthcare facilities, where the historical rate of growth of imaging data is exponential due to organic growth in procedure volumes, larger image sizes, mega-slice cross-sectional image studies, cine studies, and the availability of new image acquisition devices.

Two aspects of scalability should be considered. First, an enterprise image archive and visualization solution should support planned imaging growth, as well as unanticipated growth that can result from acquisitions and evolution in medical imaging practices and technology. Ideally, the solution should be able to architecturally scale to meet the needs of a single imaging department to the largest national or regional healthcare systems and integrated delivery networks.

Second, the solution must be cost-effectively scalable over time, in an incremental manner, to meet planned and unanticipated growth requirements. Incremental scalability allows the expansion of a solution's concurrent load capability or total storage capacity without increased user response times. A solution that cannot be incrementally scaled by adding a new load balanced application server or similar component may require an expensive "forklift upgrade." Solutions that utilize "N+1" stateless application servers in a load balanced configuration can be easily and inexpensively scaled by simply adding one or more application servers to the configuration.

## 10 Information Lifecycle Management

Given the volume of medical imaging data, records management (RM) policies are a critical topic for healthcare organizations, which manage their records based on implied or explicit RM policies that define record retention and disposition practices. Retention policies for medical images are based on a combination of legal requirements (such as HIPAA) and organizational objectives that vary according to facility. For example, a research organization may desire an indefinite retention period for images based on their potential future value. A for-profit hospital may prefer to enforce a minimum legal retention period to reduce the risk of damages associated with discovery processes or to help manage the costs of expanding storage requirements.

Information lifecycle management (ILM) describes the management of electronic information from cradle to grave, and is typically used in the context of software applications and storage devices. ILM policies may be useful for implementing organizational RM policies for medical images. In the context of medical image archives, it is important to differentiate between ILM policies that may be implemented solely at the storage device level, and ILM policies that must be implemented at the medical image archive application level.

Contrary to popular belief, medical images are not truly fixed content data. More precisely, they are quasi-fixed content data types that are subject to patient demographic and study information updates. For efficiency reasons, a PACS or medical image archive application addresses this by storing an image as a combination of static files or objects and a database containing metadata including current patient demographic information.

Retrieval of medical images via a protocol like DICOM or Web Access to DICOM Objects (WADO) requires the application to retrieve image files or objects and to dynamically merge the image with the current demographic information.

Storage devices used to hold fixed content image files or objects are unaware of the image metadata maintained in a medical image archive's database. The inability to access or modify image metadata maintained by an image archive application significantly limits the usefulness of ILM policies implemented solely at the archival storage device. ILM policies implemented at the storage device level, such as migration of images between storage tiers based on age or usage patterns, must be transparent to the image archive application. The image archive application must implement ILM policies that require access, changes, and updates to the current image metadata.

Implementation of a data retention ILM policy requires read/write access to medical image metadata. Identification of candidate images for disposition involves a codification of the RM policy that can be periodically applied to the metadata for archived images. Implementing complex policies and those that require metadata from multiple information systems can be expensive. An exceptions process is often necessary in the event that a litigation hold is requested for specific records, or when studies have some long-lived purpose. In addition, healthcare facilities should consider implementing an explicit administrator approval procedure as well as a reporting process.

The actual disposition process is most commonly a deletion of the medical images, but precise definition of deletion for a given situation is potentially complex. The simplest case is the deletion of application indexes from the image archive database. Physical deletion of files or objects from a storage device or devices may be challenging, as in the case of WORM devices, compliance devices with proprietary deletion application programming interface (API), and removable hierarchical storage management (HSM) or backup media that may be locally or remotely shelved. In addition, copies of medical images might be cached in diagnostic PACS and enterprise viewers, and references to now-deleted images may be stored in a physician's web portal or EHR application. Finally, there is increasing interest in alternatives to deletion, such as the compression of images to a "lossy" format.

A medical image archive vendor should work with healthcare facilities to clearly understand their RM policies and organizational objectives and jointly craft a mutually acceptable solution where the benefits of ILM outweigh the costs.

## Summary

An enterprise medical imaging archive is essential for hospitals, multi-facility healthcare campuses, or multi-location healthcare networks that want to improve patient care by providing clinicians with a comprehensive longitudinal view of the patient imaging record. The following ten selection criteria can be used as a checklist for IT departments when evaluating enterprise image archive and management solutions:

### PACS Vendor Neutrality

The medical image archive is agnostic to specific PACS solutions and can serve in environments where PACS and imaging systems may change over time.

### Standards-based

The medical image archive (and PACS and viewers) must adhere to the relevant DICOM and HL7 standards. More importantly, it should conform to relevant IHE Technical Frameworks to maximize out-of-the-box interoperability in heterogeneous imaging system and information system environments.

### Supports Multiple Imaging Departments

The medical image archive and viewer must be able to provide service not only to the radiology and cardiology departments, but to all points of image acquisition and utilization throughout the healthcare enterprise.

### Storage Vendor Neutrality

Selection of a medical image archive that supports current and future archival storage technologies, in a manner where the data formats and database indexing mechanisms are transparent, reduces both cost and risk over time.

### Enterprise Clinical Visualization

A secure, cache-less, fully featured, and easily deployed clinical imaging viewer that can be securely launched from the EHR is essential for sharing the longitudinal patient record with all clinical users and specialists within and outside of the institution.

### Support for Multiple Patient ID Domains

Providing diagnostic and clinical access to the longitudinal patient imaging record that spans multiple patient ID domains is possible when the medical image archive, EMPI and imaging viewers are properly integrated.

### High Availability Configurations

Users of enterprise archival and visualization services expect that the services will be available at all times. Redundant configurations provide tolerance for single points of failure without disruption to service.

### Disaster Recovery and Business Continuance

Even the most highly available solution must be prepared for disaster. Depending on organizational needs and budget, a vendor should offer multiple options for disaster recovery so that a healthcare organization can provide continuity of patient care.

### Massive and Incremental Scalability

An enterprise-class medical image archive and visualization solution should incrementally and cost-effectively scale to meet the planned and unanticipated needs of even the largest healthcare institutions – without “forklift” replacement.

### Information Lifecycle Management

A medical image archive vendor should work with a customer to clearly understand organizational RM policies and organizational objectives, and to jointly craft a solution where the benefits of ILM outweigh the costs.

## References

DICOM – Digital Imaging and Communications in Medicine, http://medical.nema.org

FDA – U.S. Food and Drug Administration, http://www.fda.gov/

HIMSS – Health Information and Management Systems Society, http://www.himss.org

HIPAA – Health Insurance Portability and Privacy Act - http://www.hhs.gov/ocr/privacy/index.html

HL7 – Health Level 7, http://www.hl7.org

IHE – Integrating the Healthcare Enterprise, http://www.ihe.net

RSNA – Radiological Society of North America, http://www.rsna.org

SIIM – The Society for Imaging Informatics in Medicine, http://www.scarnet.org/

## Acronym Glossary

API – Application Program Interface

ARI – IHE Access to Radiology Information Integration Profile

BC – Business Continuance

CAS – Content Addressable Storage

CAD – Computer Aided Detection

CPI – IHE Consistent Presentation of Images Integration Profile

COTS – Commercial-Off-The-Shelf

DR – Disaster Recovery

DSL – Digital Subscriber Line

EHR – Electronic Health Record

EMPI – Enterprise Master Patient Index

EMR –Electronic Medical Record

HA – High Availability

HSM – Hierarchical Storage Management

ILM – Information Lifecycle Management

KIN – IHE Key Image Notes Integration Profile

NAS – Network Attached Storage

PACS – Picture Archiving and Communication System

PIR – IHE Patient Information Reconciliation Integration Profile

PIX – IHE Patient Identify Cross-Reference Integration Profile

RAID – Redundant Array of Inexpensive Disks

RM – Records Management

RPO – Recovery Point Objective

RTO – Recovery Time Objective

SAN – Storage Attached Network

SINR – IHE Simple Image and Numeric Reports Integration Profile

SWF – IHE Scheduled Workflow Integration Profile

TCO – Total Cost of Ownership

VPN – Virtual Private Network

WADO – Web Access to DICOM Objects

WORM – Write Once, Read Many

XDS – IHE Cross-Enterprise Document Sharing Integration Profile

XDS-I – IHE Cross-Enterprise Document Sharing for Imaging Integration Profile

## Why Agfa HealthCare?

Agfa HealthCare, a member of the Agfa-Gevaert Group, is a leading provider of IT-enabled clinical workflow and diagnostic image management solutions and state-of-the-art solutions for capturing, processing, and managing the distribution of images in hospitals and healthcare facilities. Agfa HealthCare is a champion of interoperability and integration and leads the way in developing standards for interoperability and IHE.


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