Image-enabling the enterprise

Filling the gap for EMR systems and optimizing PACS performance

ABSTRACT

The future of medical imaging and the welfare of patients dictate that patient images are exchanged easily and rapidly across the enterprise. Ideally, patient images are part of the electronic medical record, but certainly this exchange must be effective within and among PACS, as well as RIS, HIS and other information systems. Installed PACS, however, may not be up to this task. Yet replacing a PACS system can be very expensive and disruptive. Carestream Vue can serve as the one and only PACS for a facility. Or it can work with an existing PACS, conserving resources at the facility that uses a legacy system as an archive for already stored studies.

When images are stored on several PACS, and efficiency requires these systems to work together, an integrator can be installed to create a global imaging worklist. Carestream Vue for Enterprise Workflow, powered by SuperPACS™ Architecture, can synchronize multiple worklists on disparate PACS into such a worklist, revealing information on installed PACS and applying intelligent rules to balance workload at multiple sites.

The best solution to prevent incompatibility in the future is for sites to begin installing neutral solutions. Carestream Vue for Vendor Neutral Archiving provides this neutrality, lowering the total cost of ownership of healthcare information systems by replacing multiple outdated archives and eliminating the future need to purchase application-specific archives. Another expression of neutrality is our Vue for Cloud-Based Services, a Software-as-a-Service (SaaS), which allows PACS and archiving to be purchased on a predictable fee-per-use basis.

Extending the EMR to include images can be done with a zero-footprint viewer, so named because it requires no software to be downloaded. Carestream's Vue Motion viewer can be embedded in EMR and HIS portals to access images contained in a PACS. The result is an image-enabled enterprise and EMR with access to images through virtually any browser-enabled device, running on various operating systems on Macintosh or PC-based systems.

WORDS WITHOUT PIXELS

Billions of medical images are captured in the U.S. each year. According to the market research firm IMV Medical Information Division in Des Plaines, IL, about 70 million CT and 30 million MRI procedures are performed annually, each generating hundreds if not thousands of individual images. In a year, Americans undergo 16 million nuclear medicine procedures, another 1.5 million PET scans, 37 million mammograms and 183 million X-rays. Countless more patient images result annually from cardiac cath, angiography and ultrasound procedures.

Yet, few electronic medical records include patient images, despite their obvious importance in screening for disease, making diagnosis, and determining the effects of therapy. They may not even be available within enterprises, particularly ones formed recently through the consolidation of multiple facilities using different PACS.

Images provide the context for understanding radiological interpretations. They add visual detail that makes written conclusions easier to understand and more complete. Consequently, their absence hobbles collaboration among radiologists and specialists, as it impairs communications among radiologists, referring physicians and their patients. Images can help referring physicians home in on a patient's condition, demonstrating subtle findings that are best appreciated visually. These same images can serve as communications tools, helping the physician convey information to patients about their conditions.

Given that images are a critical part of the healthcare process and the means to make them widely available is at hand, it stands to reason that they should be easily accessible throughout the enterprise, as well as an integral part of the electronic medical record.

The problem with PACS. For the most part, images are sequestered in PACS, where they may be accessed by collaborators or referring physicians only through labor-intensive efforts, particularly when enterprises use more than one PACS.

Even when enterprise-wide access is supported, all images may not be immediately available. The extraordinary volume of images generated by today's CT and MR systems can overwhelm an outdated PACS, just as the rising demand for rapid access to images can drag down its performance and functionality. Underlying this vulnerability is the dependence of legacy PACS on dedicated high-end networks, complex hardware configurations, and antiquated archiving technology. Downtimes get longer and delays happen more frequently due to failing hardware. Such failures may necessitate expensive upgrades or platform changes. Operations at facilities undergoing such changes can be seriously impaired, as this transition is accomplished at the expense of efficiency. Facilities may even experience long-term problems, if the data are not properly transferred to the enhanced or new PACS. For example, if large datasets remain outside the PACS, they might be accessed only through inefficient interfaces.

Such inefficiencies may also occur when adding a standalone workstation or thin-client system in order to perform advanced visualization techniques, such as 3D. Alternatively, they may result when healthcare facilities consolidate. Efforts aimed at reducing costs may actually incur new ones through inefficiencies created when trying to link multiple disparate PACS. Similar problems may crop up when facilities link the many data islands created by "ologies" outside the mainstream of medical imaging.

Physicians in these circumstances may depend on slow and costly methods to track down and obtain patient images, printing films or burning CDs and DVDs, wasting extraordinary amounts of time and money, ironically when these become ever more precious. This inefficiency drives up the cost of patient care. But the alternatives are worse.

Not having patient images can lead to duplicative exams. This adds even more cost, and in the case of imaging exams such as CTs, radiography and nuclear medicine, additional exams expose patients unnecessarily to additional radiation. Not having critical images is worst of all, as it introduces the potential for error, raising the specter of missed diagnoses, patient morbidity, and even avoidable death.

An avalanche of data. Installing and using healthcare information systems that provide ready access to patient data, including images, is the answer. This was, in fact, the reason PACS and RIS were among the first information systems to be embraced by the medical community. Their early adoption, however, has led in some instances to a medical Tower of Babel. Enterprises with multiple disparate PACS may not be able to share data efficiently, as their information systems are not compatible, existing as islands of digital data.

Complicating matters is the increasing demand for timely patient data, particularly among multiple sites in expanding enterprises. This has the cumulative effect of degrading the performance and functionality of information systems. This is happening just as the volume of data is growing at an unprecedented rate in the wake of modern developments in CT, MR and digital radiography. Advanced visualization, including 3D reconstructions and the fusion of data sets from several modalities, have added more pressure, as well the pending use of breast tomosynthesis with its dozen or more exposures per exam.

The end result threatens to overwhelm the ability of legacy PACS to process, distribute and archive images and other patient data.

Complicating matters for these legacy PACS is their reliance on antiquated, dedicated networks that in recent years have been made obsolete by wired, wireless and Wi-Fi networks.

In an effort to link these systems with each other, sites have constructed complex server and client hardware configurations prone to inefficiencies and failure. In the meantime, the archive technology underlying these systems has been left in the dust by massive leaps in memory.

Underscoring the shortcomings of legacy PACS is their lack of post-processing capabilities, particularly advanced visualization techniques, which are becoming increasingly common elements of modern PACS.

But just as outdated PACS struggle to keep up, challenges in data migration, including the expense in time and money to do so, are delaying the transition of sites to more advanced PACS. Often the replacement process is complex and time consuming. Early PACS adopters are learning that DICOM compliance does not guarantee easy data migration from one system to another.

A big problem is that vendors typically have their own ways of storing data. These may include proprietary data management and compression schemes. They may even involve multitier storage technologies, including various digital storage arrays, jukeboxes, and different types of media that use different types of retrieval technologies.

Under these circumstances, changing from one PACS to another may not only be challenging but highly disruptive to clinical operations, impeding the usual diagnostic process by slowing access to prior images during the transition to the new system. This can reduce productivity throughout the enterprise until the migration is done.

Government Funding Accelerating IT adoption. Adding a sense of urgency to the upgrading of image-enabled IT systems is a federal mandate on the U.S. medical community to convert from paper to electronic records. This mandate, defined by the American Recovery and Reinvestment Act of 2009, offers a near-term carrot in the form of added reimbursement for the adoption of electronic medical records through 2015 and a long-term stick poised to exact penalties for noncompliance in the years after.

Where exactly radiology fits in is not certain. Radiology was not specifically included in the first of three stages of meaningful use criteria required to qualify for the earliest of the added reimbursements. Those for stage 2, which may yet have a role for radiology, are still in development.

Radiology may get some traction in meaningful use by utilizing RIS/PACS and enterprise image access technologies. Through the modern integration of RIS/PACS, radiologists could potentially meet several key criteria. One requires the implementation and tracking of clinical decision support rules. Others call for providing patients with electronic access to health information, possibly in the form of radiology reports; patient-specific educational resources; and a summary of care records. An easy-to-deploy image viewer, embedded in the EMR, may be interpreted as addressing the need to test the exchange of key clinical information, as in images that illustrate an illness or other patient condition supporting a diagnosis.

FILLING THE INFORMATION GAP

Regardless of what happens with the government stimulus plan and meaningful use, the future of medical imaging and the welfare of patients dictate that patient images be exchanged easily and rapidly across the enterprise. Ideally this exchange will be as part of the EMR but certainly within and among PACS and health archive solutions, as well as RIS, HIS and other information systems that shape these records. Patient images should also be available for viewing outside the enterprise. Solutions are already at hand to meet these challenges, supporting the upgrade of PACS and RIS and the query of multiple information systems, just as standard Internet connections simplify their worldwide distribution.

Upgrading the PACS. When a currently installed PACS is not up to current demands, a decision must be made whether to augment or replace it. Often the choice is to install a new PACS integrated with RIS capability. The RIS may be tailored to support the EMR, as well as the construction of reports containing images. An enterprise viewer might be installed to enhance this capability. Such a viewer might be optimized to work specifically with the new PACS. Or, it may be compatible with a broad spectrum of technologies, thereby offering access to images throughout and even outside the enterprise.

But a new PACS is not always an easy choice. Replacing a legacy PACS can be very complex, expending money and time, while disrupting daily routines. Data migration is often the biggest challenge. Its problems can be mitigated, however, by installing a new-generation PACS that can leverage infrastructure from the legacy system until the transition is complete. For example, some vendors are offering metadata take-over tools that allow the legacy PACS to become an archive, making the data available as an integral part of the new PACS workflow.

A single connector. Over the years myriad PACS may have been installed at facilities that are now part of an enterprise. In order to improve the quality of patient care, while simultaneously boosting productivity and resource utilization, radiology operations at these multiple sites must be streamlined and the work coordinated. Replacing several PACS, however, may not be practical due to the cost in time and money to do so. A cost-effective alternative is a variation on the theme of turning old PACS into archives. In this case, an integrator is installed to synchronize individual worklists into a global imaging patient record for diagnosis and review. This global imaging record allows users from multiple sites to access patient images easily and efficiently so as to collaborate and balance workloads.

Staying neutral. The best solution to prevent incompatibility in the future is to install vendor-neutral solutions from this point onward. One that immediately fits the bill is the vendor-neutral archive. Because of its neutrality, this archive accepts data from platforms developed by different vendors. Serving as a centralized storehouse of radiological as well as cardiological images, for example, as well as lab reports and video files, it reduces future costs because the enterprise need not buy application-specific archives. Similarly, it cuts operating expense by reducing personnel management tasks and equipment maintenance. It also boosts efficiency by creating a common workflow across multiple locations and establishing a single point of access to patient information, allowing this information to be shared easily among authorized users.

A viewer with the light stuff. An image viewer that does not require software download (zero-footprint) neatly fills the need to provide broad access to patient images, a tough but critically important consideration in any EMR. Zero footprint offers many benefits. Like a web browser, it requires no software to be downloaded. It boots up instantly, ready to search out and display images contained in the RIS report.

It can be embedded inside an EMR system or any routinely used information system. Consequently, it allows the convenience of single sign-in, eliminating the need for repeated re-entry of passwords. Also, by embedding the viewer in a commonly used information system, users do not have to quit what they are doing in order to see images.

Especially attractive is that such Web-based viewers are not confined to a single system or facility. Because they have a zero footprint, they are compatible with just about any platform from Windows- and Macintosh-based devices. Thus, they provide secure access to images across and beyond the enterprise for physicians and patients alike.

With the viewer's reach to all clinical communities, providing diverse exposure to IT while an intuitive design requires little or no training for the end user, this technology can free up implementation time and resources.

Because a zero-footprint viewer may have to work in low-bandwidth environment, it does not necessarily require the transfer of large volumes of data over the Web. Instead most solutions depend on the server to do the vast majority of the rendering, thereby significantly reducing the volume of data to be transmitted. And, because the rendering is done on the server side, there are no data storage requirements on the zero-footprint side.

These viewers, therefore, can be easily deployed, as the software upon which they depend is loaded on the server. Consequently, they are a snap to upgrade, as software enhancements are done on the server. One caveat is that the server must be powerful enough to handle the large number of concurrent users that may seek simultaneous access to patient images.

SOLUTIONS BY CARESTREAM

Carestream Vue is a comprehensive solution that covers every aspect of image augmentation in the electronic medical record and across the healthcare enterprise from display to data archive, workflow to distribution. These can be achieved with or without data migration and the replacement of legacy systems.

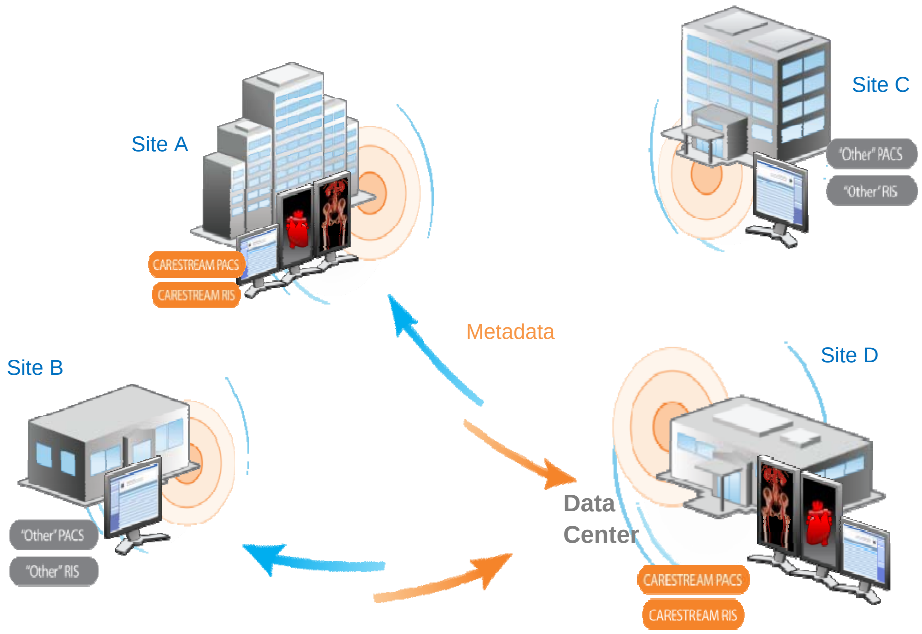
To migrate or not to migrate. Carestream Vue PACS can serve as the one enterprise PACS for a facility. Or it can work in tandem with an existing PACS, conserving the facility's resources to use this legacy system as an archive for studies already stored on it.

For those who want to replace their legacy system, we employ data migration technologies that streamline the process and minimize problems. We begin by taking a snapshot of the legacy PACS. This snapshot populates the registry to allow access to priors during data migration and while new studies are being stored on the new database. As a result, data migration can run in the background throughout the week, even during regular working hours. Alternatively, response time on the database can be maximized by migrating data only after hours and on weekends.

Facilities may avoid data migration altogether by using their legacy PACS as archives for prior studies. These PACS can then be queried by the newly installed Vue PACS. In this, an external DICOM tier, called E-SIR, takes control from the legacy PACS, turning it into an archive and providing Vue PACS with access to the legacy data.

The process begins with Vue for Enterprise Workflow that works in concert with Vue PACS. Vue Connect can scout all the studies contained in the existing PACS, creating metadata in the Vue PACS that describe each one. These metadata serve as pointers to studies stored on the legacy PACS, making all its study information visible through the Vue PACS worklist. When queries about these prior studies are made using the Vue PACS, the pointers guide the retrieval of their data. In this way we make data migration optional.

Boosting workflow throughout the enterprise. A similar process can be used to conserve the resources of an enterprise that has several legacy PACS, a process that not only extends the value of these PACS but of their accompanying storage devices. For this, Vue Connect, powered by our unique SuperPACS™ Architecture, can synchronize multiple worklists on disparate PACS into a global worklist. This worklist reveals the information contained on these legacy PACS and applies intelligent rules to balance workload at multiple sites served by these PACS, thereby boosting productivity.



Vue Connect: Enterprise Workflow

Any exam captured anywhere in the enterprise can be read by radiologists in any on-site or off-site location. The global worklist defines how these studies are routed to specialists and supports multiple patient identification numbers using IHE profiles.

Utilizing the unique SuperPACS™ Architecture, patient images and other information are securely shared among locations, while radiologists at those locations have access to powerful diagnostic tools. Vue Connect also works with vendor-neutral archives to manage multiple PACS at different facilities.

Staying neutral. Because vendor-neutral archives provide a single point of access to patient information, they facilitate data sharing among multiple users in different locations. They work independently of the PACS, storing data from multiple systems in nonproprietary formats. And they provide context management to allow information to be transferred seamlessly among different information systems.

Carestream Vue for Vendor Neutral Archiving is a complete solution with archive and viewer, lowering the total cost of ownership of healthcare information systems by replacing multiple archives and eliminating the future need to purchase application-specific archives. It can collect and store a variety of data, including medical images, lab and pathology data, video files and JPEGs to create a cohesive patient portfolio. Scalable across multiple installations, Vue Archive can be easily expanded. The archive nodes that allow this expansion can be configured to serve as backups for each other, providing redundancy and assurance against catastrophic failure. The Vue Archive also protects against undue expense in the future, supporting the cost-free migration of data to a new PACS if, or when, required. This puts the burden on vendors to earn their customers' business rather than keeping it by holding patient data hostage.

As an integral part of our RIS/PACS/reporting offerings – Vue for Radiology and Vue for Cardiology – Vue Archive acts as an IHE-XDS (Integrating the Healthcare Enterprise-Cross Document Sharing) to access medical images throughout the enterprise. Utilizing the XDS framework, our Vue Archive functions as a registry, communicating with other systems such as the RIS or HIS, which are enabled through their support for DICOM, HL7, and other IT standards. The result is a centralized repository, archiving data from multiple information systems across the enterprise.

Additional features include a master patient index and DICOM tag morphing, which standardizes data presentation throughout the enterprise. Vue Archive manages patient IDs from different sites and resolves metadata discrepancies. This user-friendly repository stores diverse clinical data, thereby enhancing the value of these data to the enterprise and, ultimately, to referring physicians and their patients. This value is further enhanced through a fully integrated viewer that can be easily deployed to virtually any device running a web browser or embedded into the EMR.

Enterprise access. Designed to distribute images throughout and beyond the enterprise, Vue Motion viewer works with virtually any browser-enabled device to augment the electronic medical record. This zero-footprint viewer requires a minimum bandwidth despite high performance and rapid access to images. As an independent viewer, Vue Motion is PACS-agnostic and can be integrated to other vendor's PACS, as well as DICOM archives and XDS repositories. Because this viewer can be easily integrated with diverse departmental systems, clinicians and referring physicians gain fast and easy access to patient data and images.

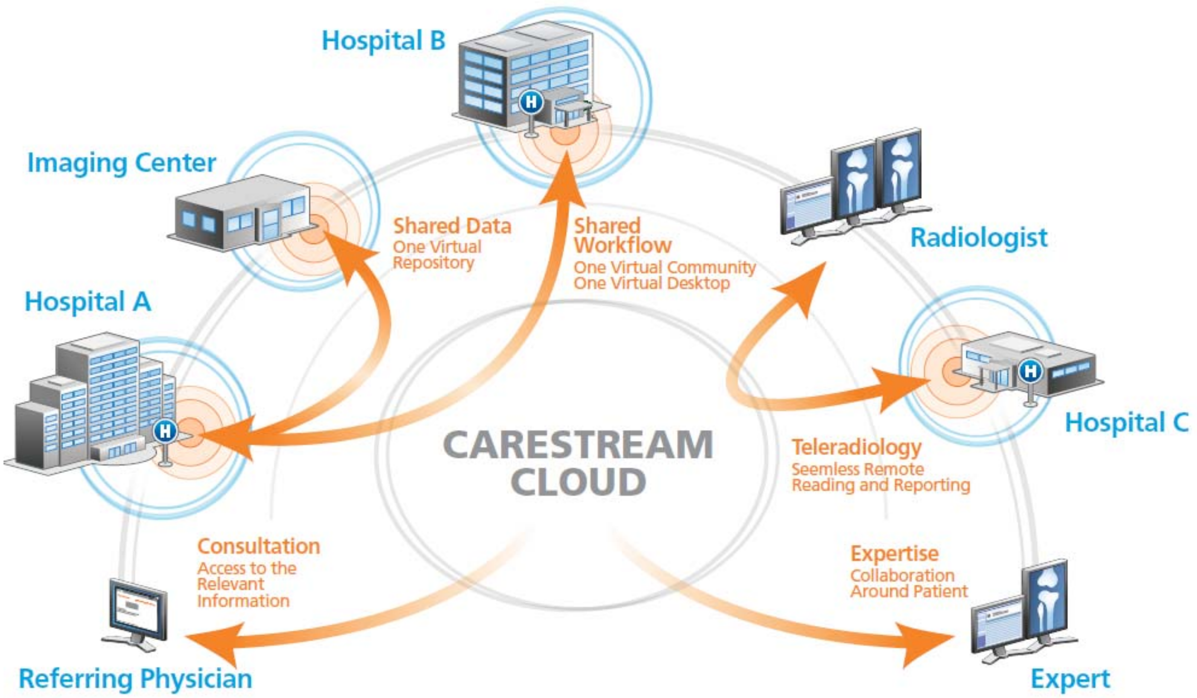
Particularly notable is its ability to be embedded in EMR and HIS portals to access images contained in a PACS, thereby image-enabling the enterprise and the EMR. The viewer can be launched without calling up a separate application or logging into another system integrated directly into an IS. Alternatively, it can be launched in a separate window without requiring a separate log-in, using a URL from within the system.

Security and infinite scalability. As the ultimate expression of neutrality, Vue for Cloud-Based Services is a Service as a Solution (SaaS), which allows PACS and archiving to be purchased on a predictable fee-per-use basis. This lowers the cost of ownership by reducing investment in capital equipment and the need for staff management personnel, as it eliminates the risk of equipment obsolescence.

Our Vue for Cloud-Based Services approach links affiliated hospitals, imaging centers, clinics and other facilities through a global patient worklist. This worklist enables providers to balance their reading and reporting workload among available radiologists, boosting productivity, accelerating the reporting process, and enhancing resource utilization.

Advanced reporting tools allow current and prior exams to be automatically compared. Advanced post-processing tools support analyses in such studies as cardiac and coronary CT, vessel segmentation, and PET/CT.

With deployment of ten data centers in five countries throughout Europe and North America, and with new centers planned for Japan and Argentina, more than a billion images are currently stored worldwide, representing more than 500 terabytes of data securely managed by Carestream using technology and services that can be scaled to accommodate our customers' growing needs.



Vue Cloud: New Collaborative Workflow

What's next. Your specific needs, in the context of your financial and IT resources, should determine what you do and how you do it. You may need a new PACS, but you might want to operate your old and new PACS together. You may want to link several PACS together or install a vendor-neutral archive as a centralized repository, an SaaS, or a zero-footprint viewer.

MORE INFORMATION

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