Planning for a Multi-imaging Center Picture Archiving and Communications System

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There are fundamental differences in planning and configuring a picture archiving and communications system (PACS) for a multisite imaging practice as compared to a hospital-based radiology department. In the for-profit, multi-imaging center environment, return on investment is more critical and the distributed nature of radiology operations presents complex communications, infrastructure, archiving, workflow, and distribution requirements. This article discusses desired outcomes for a multi-imaging center PACS and the planning, functional, technical, and support requirements necessary to achieve those outcomes. Copyright © 2001 by W.B. Saunders Company

THIS REPORT is based on experience planning and configuring a picture archiving and communications system (PACS) for a radiology practice servicing 14 metropolitan imaging centers and eight hospitals with complex, wide-area image distribution requirements. It will emphasize the ways in which such a system differs from the PACS you would configure for a hospital-based imaging service. Specific topics to be discussed include strategic planning, system configuration, support, transmission requirements, display requirements, and access to reports with images.

IMAGING CENTERS AS A BUSINESS

Because outpatient imaging centers are predominantly privately owned, they have fundamental differences from hospital-based radiology departments. The most significant difference is the desire to generate profits. This affects many aspects of the operation from what imaging modalities are offered to staff requirements, to workflow and decisions about utilizing information technology to become more efficient.

Radiology imaging centers are knowledge-based/information-based service businesses. The business processes emphasize timely distribution of radiologists' reports and images over a wide area. Since they are a for-profit business, considerable emphasis is placed on strategies to improve service, reduce costs, and expand the referral base. For this reason, there is a mandate to utilize information technologies to improve productivity and profitability.

With profitability being more critical, the imaging center has less tolerance for downtime or

implementation delays than in a hospital setting. The return-on-investment for equipment and information systems must be shorter. Costs must be justified more on hard dollars savings with fewer peripheral or soft benefits.

PACS present savings and operational opportunities for multisite outpatient imaging centers. PACS can reduce film and supply costs, decrease unproductive radiologists' travel time between centers, reduce or virtually eliminate courier costs, and consolidate archiving functions. A significant benefit for multi-imaging center operations is workload balancing among radiologists by providing online access to studies from any site. Technologist's and related personnel's productivity can be improved 15% to 25% and the number of full-time equivalents (FTE) can be reduced with PACS by eliminating manual data entry and film printing and handling. This enables greater patient throughput and thus increased revenues without an increase in personnel or capital cost for modalities.

STRATEGIC PLANNING

To attain the desired outcome of PACS in a multicenter imaging complex, greater emphasis needs to be placed on strategic planning. This is primarily due to the complexity of having multiple centers over a wide area; the centers must communicate with each other and distribute images and reports to referring physicians over a wide area. In a hospital, radiologic services are generally consolidated in one area or department. There are fundamental differences in reading areas, file rooms, infrastructure, electronic archives, physician communications, workflow, and distribution of images. These differences make the multi-im-

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aging center PACS a more complex environment requiring substantial efforts in planning and implementation.

Starting with a set of desired outcomes will help set an agenda and will dictate the functional and technical requirements of PACS. Some potential desired outcomes may include:

- Ability for radiologists to access worklists and studies from any site irrespective of where the study originated or is stored
- Ability to send selected images to referring physicians along with a report electronically
- Ability to autoroute studies to specific workstations
- Ability to access prior studies by prefetching or query
- Ability to reduce file space at imaging centers and convert to income-producing space
- Ability to download patient demographic data at the modality and track examination status
- Ability to perform quality analysis and peer review overreads
- Ability to balance radiologists' workloads
- Ability to provide overreads and subspecialty consultations via web technology

Strategic planning includes generating a PACS implementation plan. The implementation plan will be guided by the needs assessment of the entire multicenter operation. This includes an assessment of all imaging modalities, image distribution requirements, film utilization and storage needs, and study volumes by modality and by location, as well as estimating data requirements for electronic archiving, existing infrastructure and network traffic bandwidth for all applications, radiology information system (RIS) interface requirements, radiologist's reading and dictation requirements, scheduling and billing requirements, and all aspects of the imaging service operations. The assessment should yield a set of operational and business problems to be solved.

The PACS implementation should be planned to leverage existing strengths and assets located at the imaging centers. By identifying these assets, the PACS implementation plan can be more easily constructed. Examples of assets include print networks, RIS, existing infrastructure, computed radiography (CR), and Digital Imaging and Communications in Medicine (DICOM) compliant modalities.

CONFIGURING THE PACS

The PACS configuration will be structured based on physical constraints and by desired outcomes. Some basic considerations include central versus distributed archive, RIS architecture, and data distribution requirements. Sizing and scalability of the central archive and local redundant array of inexpensive disks (RAID) must be determined. The size of the local RAID can be calculated by measuring the patient study volume and the length of time each location desires to retain the study. When sizing local RAID, enough space must be included to manage the prefetching requirements.

Workstation type and locations is another consideration. Decisions must be made about the number, resolution, and type of monitors. The physical environment for reading from workstations has to be addressed, with considerations for network connectivity, power, lighting, acoustics, heat management, and workflow. Workstation locations require easy access to the RIS and dictation systems. The number of workstations will be dictated by patient volume, workflow, and the number of on-site radiologists.

The RIS/PACS interface is a critical factor in attaining the desired productivity gains. A tight specification that enables a two-way exchange of data between the modalities, RIS and PACS, needs to be written and agreed upon with the vendors. At a minimum, the interface should support DICOM Modality Worklist Commitment and Performed Procedure Step.

Because network performance is crucial to PACS performance, detailed analysis and planning of the network is essential. Once the volume of data to be transmitted has been established, the bandwidth of the network can be calculated. All applications need to be considered and not all segments will have equal demand. Calculations need to include considerations for peak demand. Multisite outpatient imaging centers have greater redundancy, fault tolerance, and disaster recovery requirements, as there are multiple locations over a wide area. Important network topology decisions will affect system performance and recovery time in the event a disaster should occur.

Estimating network traffic is a straightforward process. The calculation includes:

- Modality type and volume of studies
- Number of images per study

- Image file size by modality
- Number of prefetches by modality
- Number of times a study travels through the network

A PACS implementation for a multisite outpatient imaging center includes multiple phases to facilitate a smoother change from manual/film-based operations to an electronic operation. Several factors can help determine the phase during which each modality will be included in the PACS:

- Existing networks
- Most critical operational needs
- Digital modalities first
- Manpower requirements by site
- Budgets

The phasing decisions can have serious impact on how the system is accepted by users and by referring physicians. Initial success will encourage users to embrace the system, to be enthusiastic about solving operational problems, and to accept subsequent phases. It is a good idea to begin the phasing decisions by selecting a specific modality or operational issue that can have a positive outcome with a PACS and then make additional decisions accordingly.

SUPPORT AND PLANNING

Support and planning in an outpatient setting is more problematic than at hospitals. Typically, outpatient organizations do not have the technical people on staff with the skill sets necessary to plan, implement, and support a PACS. Therefore, from the very beginning an assessment of internal resources is needed. The organization needs to determine if they have qualified people in informa-

tion systems, networks, training, technical support, and desktop services. Deficiencies can be supplemented with consultants and new employees.

Significant support can also come from the PACS vendors, RIS vendors, modality suppliers, and network vendors. Other suppliers, such as CR, printer, film, and telecom companies, can also be part of the support network. Many of these firms have technical expertise that can help the outpatient imaging organization plan and support a PACS.

Knowing that a vendor is key in supporting a PACS, it is important to carefully assess potential vendors before contracting. When using vendors for support you should:

- Choose a vendor with technology that is proven to meet your requirements
- Choose a vendor willing to take responsibility for the RIS to PACS integration and for modality interfaces
- Work with the vendor to develop an implementation plan
- Choose a vendor willing to meet specific acceptance requirements
- Choose a vendor that will guarantee uptimes and performance parameters
- Choose a vendor that will provide upgrade support

CONCLUSION

PACS can make multisite outpatient imaging centers more efficient. However, there is a direct relationship between planning and success. The degree of success attained is proportional to the degree of planning.