SESSION VII: Radiology Reengineering in the Healthcare Enterprise

Clinical Services Assessment and Reengineering: Lessons Learned

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Healthcare enterprises often "acquire and install" picture archiving and communications systems (PACS) without examining many of the care delivery processes and information flows that will be affected. Many times these unexamined factors can delay or be the cause of failure of the PACS project. This article presents issues that were worked through as part of a PACS clinical services assessment and reengineering analysis for several US military medical treatment facilities.

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THE TIME FOR CONSIDERING the widespread infusion of picture archiving and communication systems (PACS) into healthcare enterprises has finally arrived. Many healthcare organizations and systems are looking to the early pioneers in PACS to see what works and what doesn't in the planning process. Often times, these organizations are confronted with conflicting messages about planning issues (eg, phased or all-at-once implementation), with little clear guidance available as to what is truly essential. Some organizations plan for the integration of clinical technology, but lack the experience to reengineer the care process or to adequately address their telecommunications needs. We address the issues and processes that should be examined in planning and implementing PACS and teleradiology.

Clinical services assessment and reengineering (CSAR) studies—detailed analyses of current operations and installed technology that enable sound planning for future healthcare technology acquisitions and process improvements—were performed for several military healthcare facilities in Alaska and Hawaii. The Alaska facilities were Bassett Army Community Hospital (BACH) and BACH Troop Medical Clinic, Fort Greely Medical Clinic, and Eielson Air Force Base Clinic, all in Fairbanks, and Elmendorf Air Force Base Hospital in Anchorage. The Hawaii facilities were Tripler Army Medical Center (TAMC), Honolulu, and Hickam Air Force Base Clinic, Oahu.

The CSAR studies provided a multiyear implementation plan that incorporated the clinical needs

and workflow requirements of the sites with the appropriate technology. TAMC, BACH, and Elmendorf were planned for full scale PACS; the remaining sites were planned as teleradiology sites. The Elmendorf PACS was implemented, and is now being transitioned to a newly constructed hospital. The teleradiology sites were designed to support computed radiology with film printing and film digitizers. Worklist management was planned for all imaging modalities and PACS technology to eliminate redundant patient demographic data entry.

All of the PACS and teleradiology systems were implemented according to the plans outlined in the CSAR studies and are operational today; the Elmendorf PACS transition to the new hospital was planned in a second phase of the CSAR for that facility. This discussion of CSAR is based on the lessons learned in planning for PACS and teleradiology at these facilities.

The first step in PACS planning should be a thorough needs assessment. This should include an analysis of current technology and clinical operations, as well as projections for future use. A thorough needs assessment should consider the following:

- State of existing clinical technology and its prospects for continued use, replacement, or decommission
- System-wide needs and policy for the archive
- Analysis of existing telecommunications infrastructure and the availability and cost of upgrades
- Reengineering of staffing and workflow processes
- Postwarranty considerations

Most importantly, the needs assessment should define the goals of any PACS project so that the

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appropriate technology solution is obtained. Many times, the technology obtained is not the most appropriate for that organization's clinical requirements. This often leads to costly capital expenditures that exceed budgeted amounts for sustainment, as well as acquisition.

Many healthcare providers plan a PACS based on the current technology and clinical operations, not accounting for known technology introductions and clinical trends. An example of this is the advent of direct radiography, which may mean that integration of existing radiographic table systems is unnecessary. Also, the increasing demand for magnetic resonance and computed tomography studies may lead to a decrease in other procedures; the impact of this "procedure shifting" on archive and integration requirements should be examined. Every organization implementing a PACS should conduct a clinical services assessment to determine "what" clinical care technology should be strategically incorporated into the PACS system and "when" it will be integrated. This technology analysis matches demand with capacity, and allows the healthcare enterprise to integrate the necessary acquisition devices into the PACS. Why should a hospital interface a 15-year-old radiographic/fluoroscopic (R/F) system when it will be replaced with a digital system next year (given that the capital budget has been approved)?

Telecommunications is also an underexamined planning issue. Whether the PACS is an intrahospital, intraenterprise, or interprovider system, the communication links must be examined. Placing review workstations in the intensive care unit (ICU) or surgical suites is common in PACS design, but image and demographic data transmission times to these locations could be unacceptably long due to limitations of the network. An underutilized dual-head review station in the ICU (or 20 underutilized review workstations throughout the hospital) is a costly investment, and has caused administrators to reject multimillion dollar PACS systems in favor of current film-based operations with their inherent delays and inefficiencies. Also, once a healthcare provider sends an image out of its facility, the cost and speed of transmission is an uncertainty. What's acceptable for subspecialty consultations in terms of transmission time may not be appropriate for nighttime, at-home reading. The goals of the healthcare provider with regards to PACS and the input of the users (radiologists, other

physicians, and technologists) have to be incorporated into designing the telecommunication infrastructure needs. At a minimum, a gap analysis of current versus "post-PACS" communication infrastructure requirements should be performed to confirm whether or not clinical expectations for transmission and display times can be met.

Rural healthcare providers must also examine telecommunication methods and costs. Some areas do not have access to high-speed connections such as asynchronous transfer mode (ATM), and if they do the transmission line may be extremely cost-prohibitive to install and maintain. Wireless transmission is an option, but one that has to be gauged in terms of its cost-effectiveness and reliability. Microwave transmission may not be suitable for mountainous regions or areas frequented by heavy fog or snow; satellite transmission is an option, but access to the satellite, unless solely owned by the healthcare organization, may be restricted to inconvenient times at prohibitive costs.

The clinical service assessment should also examine policy issues regarding archive development. Primarily, what will the healthcare enterprise's policy be about image retention and compression? Many organizations retain years of film, either on-site or with the use of off-site storage facilities. Filmed images create a great demand for space within a facility; with the advent of the digital image environment, images will be stored on tape, disc, or some other as-yet-to-be-determined medium, with much less demand for space. The digital image may even be stored miles away by a third-party storage provider. However, the archive will still be a physical entity, regardless of where it is located, and its size and cost will be partially dependent on the amount of images stored. There most likely is a technology difference between storing 3, 5, 7 or more years of images as the bytes of data increase concurrently with procedural volumes. A facility-wide policy may be appropriate for centralized archival; however, a standard sized archive to be used at each facility in a decentralized solution may grossly overestimate archive needs for certain facilities. Each facility's image storage requirements should be addressed individually.

An enterprise-wide policy on image compression should also be established during the planning stage. As the debate is expected to continue regarding image quality between lossless, visually lossless, and lossy compression methods, the need for a

standardized approach is paramount. Short-term archival may have different review needs (ie, diagnostic) versus long-term archive, and the impact of compression on archival size and cost is a concern as well. In a multisite enterprise, risk management requires a standard compression policy.

It is never too early to start planning for maintenance and quality assurance (QA), and we recommend that any healthcare organization implementing PACS assess its maintenance needs before the initial Request for Proposal is written. The acquisition time is when the healthcare organization has the most power to negotiate favorable terms for maintenance, and also when it can best define which vendor is responsible for each maintenance/QA action. Organizations should also determine how the PACS will be tested for acceptance; this is important as the results may serve as the baseline for future QA testing. If acceptance testing is not defined nor conducted, many organizations have little recourse in future performance resolution efforts.

Postimplementation reengineering of care processes (actually, the planning for this should begin well in advance of implementation) has to be considered as well. By involving radiologists, technologists, information technology (IT) representatives, and other health professionals early in the clinical services assessment, hospital and depart-

ment administrators may find it easier to change workflow in order to achieve the savings associated with PACS (eg, quicker image read/report times, fewer repeat studies, etc). Retraining film library, biomedical engineering, and IT personnel may be easier when they have been involved in transition planning.

The need for thorough upfront planning has been demonstrated, unfortunately, by those organizations that did not perform a CSAR-like analysis. All too often an organization will embark on a major capital equipment deployment like PACS and tele-radiology without adequately defining the clinical scenario it wishes to achieve. A properly executed CSAR addresses the issues necessary to ensure a smooth transition to the digital environment.

Installation, integration, and technology problems surface at some time in the transition process. The success of PACS implementations in Alaska and Hawaii shows that, with proper planning and the use of CSAR studies, healthcare organizations can avoid some of the problems discussed here. As PACS become more commonplace in hospitals, and as they expand to support other clinical services, informed decision-making is a must. PACS is not just a radiology-IT project; PACS design and implementation requires enterprisewide planning that can be accomplished via CSAR studies.