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## Reading Room Essentials

(December 1, 2006) - Contributed by Erin Chesson

Healthcare facilities are revamping digital radiology reading rooms with the basic design foundations &mdash; lighting, ergonomics, acoustics, room design and connectivity.

PACS, radiology information systems and electronic medical record systems are designed to quickly and effortlessly bring information to the user with the click of a button. As healthcare facilities deploy and integrate these technologies, the end-users, particularly radiologists, must re-engineer their workflow. At the same time, radiology reading rooms also must be re-engineered and renovated for digital image interpretation. The task is challenging, but more healthcare facilities are sharing their success stories and proving their creativity in the task of deploying a digital and ergonomic radiology reading room.

The foundation of digital radiology reading room design are lighting, ergonomics, acoustics, room design and connectivity. The Baltimore VA has a lot of experience in these areas &mdash; having been a PACS pioneer and since then a well-known think-tank for fine-tuning reading efficiency. Just this fall it took another big step, going live with its Radiology Reading Room of the Future.

&ldquo;Part of the challenge is that reading in a digital environment is very different from reading in a conventional film-based environment,&rdquo; says Eliot Siegel, MD, professor and vice-chair of the Diagnostic Radiology Department at the University of Maryland School of Medicine and chief of imaging for the VA Maryland Healthcare System. When film boxes are replaced by computer monitors, radiologists spend most of their time sedentary, primarily using a keyboard and mouse. A poorly designed room that overlooks the importance of ergonomics can cause occupational injuries such as eye strain, lower back strain, carpal tunnel syndrome and fatigue.

The Radiology Reading Room of the Future &mdash; now the main clinical radiology reading room at the Baltimore VA &mdash; consists of five separate reading areas with five different furniture and lighting solutions in each, and serves three purposes. &ldquo;This is an actual clinical reading room used by five radiologists,&rdquo; Siegel explains. &ldquo;It is also a show room and demonstration area. Lastly, it is a research laboratory where we make changes and modifications [to the workstations] for various studies.&rdquo;

The room features individual ventilation and light controls, adjustable workstations so radiologists can read standing up, reclining chairs with monitors that adjust according to the angle at which the radiologist is sitting, biometric security, white noise generators, adjustable LCD windows that can be made clear or opaque using a program on the workstation, self-calibrating Barco monitors (Coronis 3MP and Coronis Color 3MP DL systems) for remote QA, 4MP 30-inch Barco monitors for teaching and collaboration, a focused sound speaker, and acoustic baffles on the walls and ceilings.

A works-in-progress, the room is changed and improved based on user feedback. &ldquo;There are so many issues to consider other than taking down light boxes and putting in workspaces once PACS is implemented,&rdquo; opines Siegel. &ldquo;Not paying attention to the essentials, radiologists will be less productive, less accurate and they are going to be setting themselves up for increased stresses.&rdquo;

### Essentials of design

It is important to consider when is the right time to outfit a digital radiology reading room. Many suggest it be accomplished at the same time PACS is installed. &ldquo;This sort of thing needs to be planned well before the PACS goes in because there is significant opportunity to redesign the layout of the room as well as the furniture, wall mountings and utilities,&rdquo; says John Romlein, managing partner, Qualiteering Labs, LLP. &ldquo;A lot of things really need to change in a reading room to really redesign it.&rdquo;

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Is it affordable? "Yes, not everyone needs to go building new walls and changing the floor plan," says Romlein. "You can easily put up partitions of a less permanent nature that provide light and sound baffling between reading positions without having to build walls."

However, Romlein explains some basic elements to consider in designing a digital reading room:

- Light control: "You want to darken the room more than it has been in a film environment," he says. "Computer images are not as bright as film images." Electronic patient images should be the brightest thing in the room. Solutions include light dimmers as well as wall colors, paint and rough (not glossy) textures that absorb light, such as grays, blacks, blues or dark red.
- Sound control: Now that light boxes and the traffic associated with them are eliminated, hospitals can make the reading environment more conducive to concentration for the radiologists, says Romlein. Solutions include noise baffling mechanisms: sound absorbing materials on the wall, partitions (that do not have to extend from the floor to the ceiling, but enough to minimize sound) and carpeting.
- Macro-ergonomics: This involves an organized layout of the reading room. "You do not plan for a person at a desk, but you plan it for a person in an environment where the workstation is a part of that environment," explains Romlein. How do you get in the room, get around, how easily you can consult with someone else, and can you get in and out of the room without creating a bottle neck?
- Micro-ergonomics: This involves the radiologist sitting at his or her desk — answering the phone, using speech recognition, writing notes, using the mouse and key board and flipping films. "These are the things that the radiologists do in the very repetitive process of reading," says Romlein.
- Entrance/Exit: "No light or noise from an adjacent room should come flooding into the radiology reading room," says Romelein. "While you want openness for ease of walking around and a greater sense of space, you do not want it too open so that noise and light interferes from one space to another."

#### Finding what works best

The radiology department at Memorial Sloan-Kettering Cancer Center in New York City has had quite a bit of experience with digital image interpretation and reading room design, having installed PACS in 1999. Some of their reading rooms were designed pre-PACS and some were added for digital reading as services expanded, says Lawrence Schwartz, MD, vice chair of technology development. Today, the medical center has nine main clinical reading rooms.

While no two reading rooms are the same, they all include the ingredients for radiologists to read efficiently and accurately in a PACS environment: ergonomic workstations, appropriate lighting, noise reduction, and well-planned entrances and workstation layout. "We have general lighting in the rooms as well as individual lighting at each workstation," says Schwartz. "We found that it works out best when the light is either wall- or ceiling-mounted rather than table mounted."

Appropriate lighting and noise reduction are critical factors, says Schwartz, especially sound control since radiologists use voice recognition. Three flat-panel displays have been mounted on a height-adjustable, ergonomic workstation — an AFC Industries's Dual Tier Cart. To permit what Schwartz calls semi-privacy, partitions between each workstation do not extend to the ceiling. While the radiologists are not isolated at their workstations, they have a fair amount of quiet and privacy. Carpet or noise baffling materials cover the partitions, and carpet covers the floor. "Cooling is very important in the reading rooms due to the heat generated by the flat-panel monitors," adds Schwartz. Since the use of light boxes has dwindled, they have been placed outside or at the entrance of the reading rooms.

In terms of lessons learned, Schwartz says he is surprised at the number of radiologists who prefer to read while standing. But it is a learn-as-you-go experience and changes have been made accordingly. Each reading room and each

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workstation evolves with greater integration of technologies. "How you go about this really depends on the room itself," explains Schwartz. "There are some reading rooms where our workstations are in the corner, others where the workstations are all in a row perpendicular to the wall. However you can accomplish limiting light and noise between the workstations is an optimal place to begin your design."

### Options are important

Since radiologists tend to be more sedentary in a PACS setting, digital radiology reading rooms typically incorporate adjustable furniture. The University of California Los Angeles Medical Center installed Anthro Corp.'s Carl's Table in their renovated reading rooms. PACS Application Manager Ric McGill says the rooms are designed so that physicians can read independently or in a collaborative fashion. "You want your workstation to be very dynamic," he says. "Our radiologists change their reading position approximately two times a day. Some physicians may never stand and others may never sit, but both options should be available."

In the age of IT, workstations need to accommodate multiple applications, such as PACS, RIS and speech recognition. Given just how many options can go into the design of an ergonomic PACS reading room, McGill suggests a number of individuals be involved in the process. "You have to have a physician champion," he says. "You have to have motivated administration who can see the benefits of doing a new room because there are costs involved. Upper level management has to be dedicated to this. Your IT staff has to be involved and also be aware of the types of networks needed in the room."

A multi-person team helped facilitate the simultaneous implementation of PACS and a digital radiology reading room at Elliot Hospital, a 296-bed hospital in Manchester, N.H. "From the literature out there as well as the trade shows we went to, we knew that we were going to have to redesign our reading room when we implemented PACS," says PACS Manager Pamela Goldthwaite. "When we did site visits to look at a hospital's PACS, we also made a point to look at their radiology reading rooms. We paid attention to how the rooms were designed as well as the installed equipment."

The PACS team and reading room designers, which included outside consultants, also asked the radiologists what they needed to consistently and cohesively operate throughout the day using digital equipment. Based on physician input and the team's own research, they installed adjustable workspaces (Redrick Technologies' Redrick View Comfort workstation) with a flat-screen view box, a microphone for PowerScribe speech recognition and a regular phone to communicate with outside, referring physicians.

Once the hardware had been selected, IT Project Leader Jamie Sheehan says the workspaces were further tweaked for a more workflow efficient design: monitors were moved above and off the radiologists' counter space; lighting was factored into the equation; and ergonomically designed chairs with various settings and arm rests were selected by the radiologists. From the workspaces to the chairs to the layout of the room itself, Sheehan says they engaged the physicians as much as possible.

"When we went live with PACS, the room was already set to how the radiologists wanted," says Sheehan. "They were able to primarily focus on the applications at hand versus whether the chair was comfortable for their back or whether the phone would light up properly so that they could see it with the lighting they had chosen."

PACS and a well-designed reading room have boosted productivity of Elliot's department and feedback from all the radiologists has been very positive. "The radiologists love it," says Goldthwaite. "They felt that we were interested in all their opinions in the decision-making process. The radiologists felt we installed everything we could to make their environment a comfortable place in which to work."

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It was a little difficult and cumbersome to simultaneously go live with PACS and a new reading room, but the end justified the means. "If I were to give a recommendation to facilities implementing PACS, I would tell them to take the time to design the reading room at the same as planning for, implementing and going live with PACS," says Goldthwaite.

### Improving report turn around time

Similarity is essential to the design of Inland Imaging's digital radiology reading rooms, says PACS Manager Mike Lent. Since Inland went live with a Stentor PACS in late 2001, Lent has been involved with creating digital, ergonomic reading room environments for the Spokane, Wash.-based practice. More than 55 radiologists read studies originating from Inland's four local outpatient imaging centers, one remote center in Seattle as well as from over 20 regional hospitals.

How do large imaging volumes and multiple locations factor into PACS and reading room design? "On any given day, we have more than 20 radiologists on staff in different reading rooms scattered throughout our enterprise." From a reading room in a hospital or imaging center, Inland radiologists will read high volumes of studies from multiple modalities and spend long periods of times at their workstations.

"We started with ergonomics in mind, but after we got into the heavy volume of reading, we discovered that ergonomics wasn't just a nicety, it was critical to the success of our radiologists," Lent says. "When we did not have proper ergonomics in certain areas, we would receive complaints from doctors in these areas, such as neck strain or repetitive stress problems."

Since Inland's radiologist read in different locations every day, consistency is required throughout the reading rooms. "With that in mind, we have defined our standard reading room which addresses size of room, the reading station itself, furniture, lighting and even the look," says Lent. The reading rooms share a string of similarities, including Biomorph's Mako desk, separate heating and air conditioning controls, subdued lighting, ergonomic chairs and a minimum four-monitor configuration.

"In our setup the radiologists read in different reading rooms at different locations on a daily basis," says Lent. "We have a high volume of studies, in excess of 1,000 studies read on a daily basis, so it is critical that our reading rooms are similar in all locations and ergonomic in design. We are continually looking for new methods to ease the strain placed on the radiologist by long hours in front of a radiology workstation."

### Conclusion

Poorly designed digital radiology reading rooms can hinder the success of PACS, slow report turnaround, cause unnecessary occupational stresses for the radiologists, and decrease productivity and perhaps even accuracy. As flat-panel displays replace light boxes, healthcare facilities are revamping reading rooms to create greater efficiency and handle larger image volumes.

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A digital mammography reading room at Lahey Clinic in Burlington, Mass., features a mammography alternator to the left at 90 degrees of the workstation for reading historical, analog mammograms. The desk offers a dimmable desk lamp to the right, ergonomic chair and AFC's Dual Tier cart. The two portrait monitors are Planar C5i displays (5MP, high-resolution autocalibrating grayscale), while the display at left is a Planar PX1910M. Wires behind and under the desk are organized, combined neatly and contained in flexible conduit systems to enable a neat appearance and easy cleaning.

This small reading room at Lahey Clinic in Burlington, Mass., adjoins a larger reading room via a common hallway. The workspace is best suited for one person but can be used for consultative purposes. Light absorption materials — dark wall panels with sound-absorbing materials, flat black paint on the walls, black ceiling tiles and hangers — create a dark reading environment. AFC's Dual Tier Cart desk includes an adjustable front work surface for the keyboard, speech recognition device, and mouse, and an adjustable tier for the digital, flat-panel displays to the right (Planar Systems's C3 3MP) and a low resolution color monitor to the left (Planar PX1910M).

Leslie Fort, MD, sits in the 'Radiology Reading Room of the Future' at the Baltimore VA Medical Center that has Xybix furniture, chair and ergonomic technology solutions and a GE Centricity PACS workstation.