The Filmless Radiology Reading Room: A Survey of Established Picture Archiving and Communication System Sites

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The purpose of this study was to survey radiologists experienced in soft-copy diagnosis using computer workstations about their current reading room environment, their impressions of the efficacy of their reading room design, and their recommendations based on their experience for improvement of the soft-copy reading environment. Surveys were obtained from radiologists at seven sites representing three major picture archiving and communication system (PACS) vendors throughout the world that have had extensive experience with soft-copy interpretation of radiology studies. The radiologists filled out a detailed survey, which was designed to assess their current reading room environment and to provide them with the opportunity to make suggestions about improvement of the PACS reading rooms. The survey data were entered into a database and results were correlated with multiple parameters, including experience with PACS, types of modalities interpreted on the system, and number of years of experience in radiology. The factors judged to be most important in promoting radiologist productivity were room lighting, monitor number, and monitor brightness. Almost all of the radiologists indicated that their lighting source was from overhead rather than indirect or portable light sources. Approximately half indicated they had the capability of dimming the brightness of the overhead lighting. Most radiologists indicated that they were able to adjust room temperature but that they did not have individual temperature controls at their workstations. The radiologists indicated that the most troublesome sources of noise included background noise, other radiologists, and clinicians much more than noise from computer monitors, technologists, or patients. Most radiologists did not have chairs that could recline or arm rests. Most did have wheels and the capability to swivel, both of which were judged important. The majority of chairs also had lumbar support, which was also seen to be important. Radiologists commonly adjusted room lighting and their reading chair, but rarely adjusted room temperature or monitor brightness. The median number of hours spent at the workstation before taken a "break" was 1.5. Common recommendations to improve the room layout included compartmentalization of the reading room and availability of the hospital/radiology information system at each workstation. The survey data suggest several areas of potential improvement based on radiologists' experience. Optimization of soft-copy reading room design is likely to result in decreased fatigue and increased productivity.

DESPITE THE LARGE AMOUNT of research that has been done in the area of computer workstation, network, server, and system architecture optimization, there has been a paucity of work done in the area of radiologist and clinician room design improvements. As workstation and picture archiving and communication system (PACS) performance continue to improve, the rate-limiting step with regard to radiologist and clinician productivity will increasingly become human fatigue and limitations of the human/machine interface.

A number of studies performed at the Baltimore Veterans Affairs Medical Center have demonstrated that radiologist fatigue levels and performance are related to environmental factors such as monitor brightness and ambient room light in addition to workstation software enhancements. Ongoing research at our laboratory is being conducted to investigate other environmental variables, such as noise, temperature, seating ergonomics, and so on.

Soft-copy reading environments vary considerably from one imaging facility to another and even within an imaging department. This is particularly true of clinical areas such as the operating room and the intensive care unit environments, where it can be particularly difficult to control the reading room environment.

The purpose of the study was to survey radiologists experienced in soft-copy diagnosis using computer workstations about their current reading room environment, their impressions of the efficacy of their reading room design, and their recommen-

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dations based on their experience for improvement of the soft-copy reading environment.

MATERIALS AND METHODS

Surveys were obtained from radiologists at seven sites throughout the world that have had extensive experience with soft interpretation of radiology studies. These sites were the Baltimore Veterans Affairs Medical Center, Beth Israel Medical Center, Brooke Army Medical Center in San Antonio, TX, Mayo Clinic in Jacksonville, FL, Samsung Medical Center in South Korea, the Medical University of South Carolina in Charleston, and the Hammersmith Hospital in London, England.

The radiologists filled out a detailed survey, which was designed to assess their current reading room environment and to provide them with the opportunity to make suggestions about improvement of the PACS reading rooms. The survey data were entered into a Microsoft Excel database (Microsoft, Redmond, WA) and results were correlated with multiple parameters, including experience with PACS, types of modalities interpreted on the system, and number of years of experience in radiology.

RESULTS

The factors judged to be most important in promoting radiologist productivity were room lighting, monitor number, and monitor brightness. Almost all of the radiologists indicated that their lighting source was from overhead rather than indirect or portable light sources. Approximately half indicated that they had the capability of dimming the brightness of the overhead lighting. Most radiologists indicated that they were able to adjust room temperature but that they did not have individual temperature controls at their workstations. The radiologists indicated that the most troublesome sources of noise included background noise, other radiologists, and clinicians much more than noise from computer monitors, technologists, or patients. Most radiologists did not have chairs that could recline or arm rests. Most did have wheels and the capability to swivel, both of which were judged to be important. The majority of chairs also had lumbar support, which was also seen to be important. Radiologists commonly adjusted room lighting and their reading chair, but rarely adjusted room temperature or monitor brightness. The median number of hours spent at the workstation before taken a "break" was 1.5. Common recommendations to improve the room layout included compartmentalization of the reading room and availability of the hospital/radiology information system at each workstation.

DISCUSSION

Radiologist reading rooms in current clinical soft-copy environments have typically not been designed prospectively for the different requirements of a filmless environment. Despite the research which has suggested a reduction in both productivity and accuracy in a room with suboptimal lighting, most current reading rooms are not equipped with proper indirect light sources. There have been relatively few attempts to minimize the background noise associated with the monitors and other equipment. Radiologist chairs and workstation desks and tables are rarely optimized for a soft-copy reading environment. Radiology reading rooms continue to be large with multiple radiologists interpreting studies in a noncompartmentalized space. This is a legacy from film-based reading room environments in which films were brought to a central location in the room for easier distribution to the radiologists or to be hung on film alternators. Despite these suboptimal reading room environments, radiologists continue to spend approximately 1.5 hours between breaks.

CONCLUSIONS

The survey data suggest several areas of potential improvement based on radiologists' experience. Optimization of soft-copy reading room design is likely to result in decreased fatigue and increased productivity. Further research should be performed to determine the impact of modifications in ambient noise, temperature, and ergonomics of the chairs used by radiologists and clinicians, as well as alternative room layouts such as a compartmentalized room.