American Board of Radiology Computer Test Center

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In 1997, the American Board of Radiology (ABR) determined to develop a computer-based examination and to create a test center for administration of computer-based examinations. In implementation of its plan, the Board has developed a flexible examination platform, well-adapted to the graphics needs of an image-based examination, and at the same time, compatible with test centers being developed by other medical specialty boards in terms of hardware, software, and candidate surroundings. A test center for secure proctored examination of up to 33 candidates has been created at the Board's headquarters in Tucson, AZ. The decision of the ABR to employ computer-based testing as a part of its recertification process represents an important step of significance to the entire field of radiology, embracing methods that are rapidly becoming integral to the practice of radiology in the acquisition, display, and management of diagnostic imaging information.

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THE AMERICAN Board of Radiology (ABR) was formed in 1934 with the mission of serving the public and medical profession by certifying that its diplomates have acquired, demonstrated, and maintained a requisite standard of knowledge, skill, and understanding essential to the practice of radiology, radiation oncology, and medical physics.¹ Since its inception, the ABR has based its certifications on the successful completion of training and the results of written and oral examinations of candidates. Today, the ABR offers certification in Diagnostic Radiology, Radiation Oncology, Physics, and the subspecialties of Nuclear Radiology, Vascular and Interventional Radiology, Pediatric Radiology, and Neuroradiology. Each year more than 2,000 candidates sit for the oral and written examinations of the ABR.

Until recently, lifetime certificates in Diagnostic Radiology, Radiation Oncology, Medical Physics, and Nuclear Radiology have been granted, with no

expiration date. Although some certificates currently offered by the Board are time-limited, beginning in 2002, all certificates issued by the ABR will expire after 10 years and recertification will be required to extend certification for an additional period. As a result of this change in policy, the total number of examinations the ABR will be required to administer for certification and recertification in primary disciplines and for subspecialties is projected to grow rapidly in the coming decade. In planning for this major increase in demand for its examinations, the ABR has evaluated a variety of options, including conventional written and oral examinations, take home self-assessment recertification examinations, and computer-based recertification examinations. In the interest of maintaining a secure and proctored examination for recertification, the ABR determined in 1997 to develop a computer-based examination and to create a test center for administration of computer-based examinations. In implementation of its plan, the Board wished to develop a flexible examination platform, well adapted to the graphics needs of an image-based examination, and at the same time, compatible with test centers being developed by other medical specialty boards in terms of hardware, software, and candidate surroundings. Compatibility with other test centers was of particular importance in view of the desire of several medical specialty boards to share and exchange access to their test facilities, permitting candidates in a given specialty to have the option of selecting the most convenient of several test centers for their examination.

Computer-based examinations (CBEs) are not new to medical specialty boards. Currently, CBEs are used or are being considered for certification or recertification by the Boards of Pathology, Pediatrics, Family Practice, Internal Medicine, Neurology and Psychiatry, and Obstetrics and Gynecology.² Some of these boards have gained significant experience in the development and administration of CBEs. For example, the American Board of Pathology, administered its first CBE in 1995 and now has a test center at its headquarters in Tampa, FL consisting of a 72-workstation facility administering more than 2,500 examinations each year.

CBEs offer a variety of evaluation formats,

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0897-1889/00/1302-1013\$10.00/0

doi:10.1053/jdim.2000.6827

ranging from the presentation of multiple choice questions in a fashion similar to a conventional written examination to highly interactive examinations. CBEs are well suited for adaptive testing and offer the opportunity for evaluation of skills using computer simulation and other interactive approaches. CBEs also offer the opportunity to present examinations using a variety of media, including written text, high-resolution images, video, and audio—all important in the current evaluation of candidates for certification by the ABR.

In 1997, the ABR developed specifications for its test center and in October 1998 completed the construction, installation, and testing of its examination facility at its headquarters in Tucson, AZ. The test center was designed to permit secure proctored examination of a maximum of 33 candidates. The test center consists of 32 individual computer workstations (Fig 1) in direct visual contact with a proctor (Fig 2) and a private office containing an additional examination workstation for use by disabled candidates. The proctor's workstation is housed in an acoustically isolated room overlooking the examination workstations. A public address system allows broadcast of general announcements and orientation instructions into the examination. Computers at examination workstations, the proctor's workstations, and the examination file server are linked by a dedicated 100-Mbyte Ethernet network. To maintain security of examination materials and results, the test center network is completely isolated from the ABR office network and from external access.

Requirements for examination workstations were

Fig 1. American Board of Radiology Computer-Based Examination Center. View of the test center with 32 individual examination workstations.

Fig 2. American Board of Radiology Computer-Based Examination Center: Proctor's booth. (A) View from examination room. (B) View from proctor's booth.

primarily determined by the need for rapid high-resolution display of grayscale and color images, digital video, and compatibility with hardware used by other medical specialty board test centers such as the American Board of Pathology. Security of examination materials, data backup, and redundancy to prevent loss of examination data during testing were additional critical requirements. Additional details related to hardware and network are provided in Table 1.

Customized test development, scoring, and administration software were developed for the ABR by Assessment Technologies Inc, Lexington KY. This team, headed by Richard Rovinelli, PhD, has extensive experience in developing testing applications for the American Board of Family Practice and the American Board of Pathology. Four major applications have been developed for the ABR. The first is a highly customizable item banking application for classification, storage, retrieval, and man-

Table 1. Hardware Specifications

Examination workstations:
Gateway GP6-350
Processor—350 MHz Pentium II
Memory—64 Mbyte RAM
Video—8 Mbyte ATI Rage Pro
Network—3COM 10/100 Ethernet card
Disk storage—6.4 GByte hard drive
Audio—Integrated Sound Blaster AudioPCI 64 (not used currently)
Operating System—WinNT workstation
Display—19" VX900 gateway monitor operating (1,280 × 1,024, 24 bit color)
Examination file server:
Gateway NS8000-333
Processor—Dual processors 333 MHz Pentium II
Memory—512 Mbyte RAM
Video—2 Mbyte integrated PCI graphics accelerator
Network—Adaptec 10/100 Dual port Ethernet card
Storage—3-channel ADAC RAID: 6 × 4.2 GB SCSI drives providing 19 GB usable storage)
Backup: 12/24 SCSI DAT
Audio—Integrated Sound Blaster AudioPCI 64
Operating System—NT 4.0 Server
Display—15" color monitor
Examination Network:
2—10/100 3COM SuperStack II 3300 Switches
Matrix cable backbone connection
TCP/IP
Fully isolated from the internet

agement of written test items and images. A second application permits construction and testing of CBEs in a variety of formats. A test administration application is used to deliver test items to candidates, and collect responses. A fourth module handles administrative tasks, including candidate demographics, registration, scoring, and item performance data.

Immediately before test administration, questions are installed on the examination server and copies downloaded to individual workstations. The examination is begun under control of the proctor and as the examination proceeds, responses to questions are stored simultaneously on each candidate's individual workstation, as well as on the examination server. This duplication of data is of particular importance, as it ensures that the candidate's answers are totally protected in the event of failure of either the server or the workstation during the examination. Software permits the proctor to monitor the progress of each candidate during the

examination, to respond to questions from individual candidates during the examination, and to pause the examination for an individual candidate or for the entire group, as necessary. Scoring may be done immediately at the completion of the examination, providing the option of rapid communication of results to candidates.

The ABR administered its initial computer-based tests in April and September, 1999. The first examination in April 1999 was given to 26 candidates from the American Board of Family Practice who sat for certification in Sports Medicine examination. In September 1999, a recertification examination in Radiation Oncology was successfully administered to 55 candidates. An exit survey of 35 examinees participating in the Radiation Oncology recertification examination indicated little prior experience with CBEs, with 80% of candidates reporting no prior experience, 14% with some prior experience, and 6% with extensive experience. Despite the lack of prior experience with CBEs, 94% reported that they were very comfortable using computers and overall satisfaction of candidates with the examination process was high, with 97% rating the test facility positively and 100% the candidates giving favorable ratings to other aspects of the examination process.

The decision of the ABR to employ computer-based testing as the basis of its recertification process represents an important step of significance to the entire field of radiology. By recognizing, adopting, and applying modern computer technology to the evaluation of its candidates, the ABR has embraced methods that are rapidly becoming integral to the practice of radiology in the acquisition, display, and management of diagnostic imaging information. Through the growth and development of its CBE resources, the ABR looks forward to better fulfilling its mission of serving the public and medical profession through its certification process.

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