

Digital mammography scores big

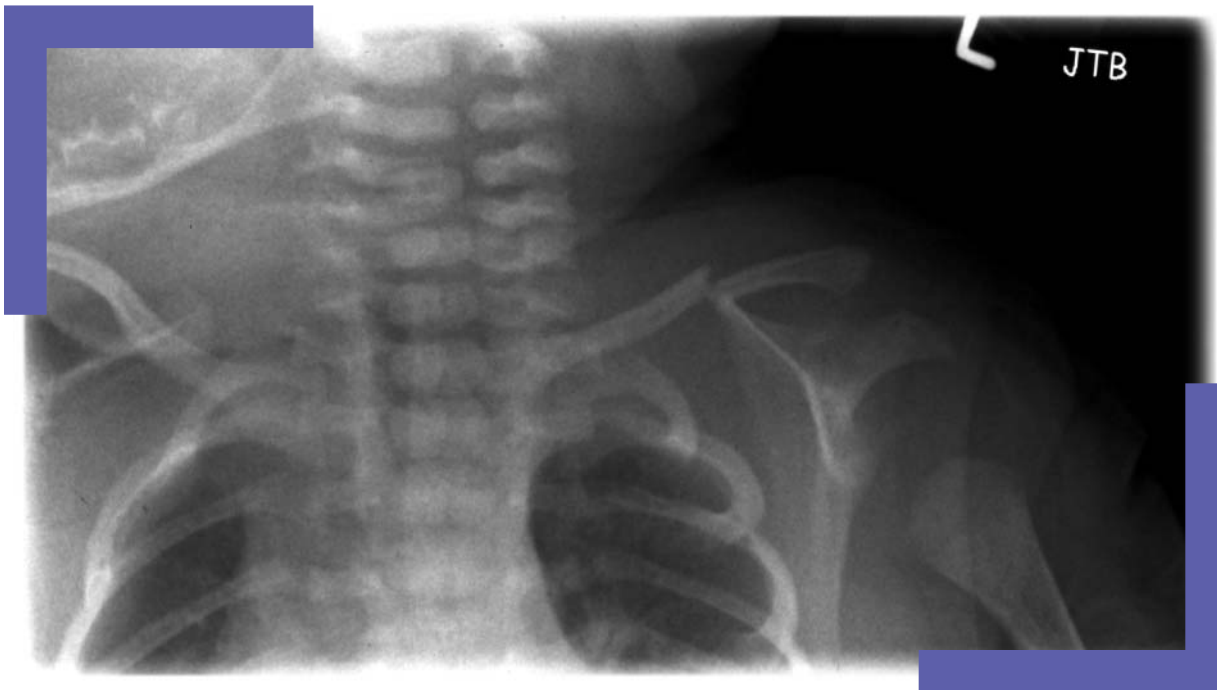
Multicenter trial finds it
superior for screening
younger women

Zoom & Pan:
DMIST puts digital
mammography in
radiology's fast lane

Technology Update:
New dual-side imaging
plate reduces dose while
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Best Practices:
How to choose
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image showcase



This **pediatric clavicle** was imaged using Fuji's new dual-side imaging plate, called the ST-BD. ■

For more information about this technology, see the story on page 6.

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“ This digital mammography study demonstrates how **new technologies** are expanding our ability **to detect breast cancer earlier** in women. ”

— Dr. Andrew C. von Eschenbach,
Director of the National Cancer Institute,
speaking about the Digital Mammography Screening Trial.

DMIST puts digital mammography in radiology's fast lane

After years of data collection and \$22 million in expenses, it's nice to know that digital mammography can hold its own against film. That's pretty much what everyone expected from the Digital Mammographic Imaging Screening Trial (see story on page 4). What came as a very pleasant surprise is that the digital exam appears to be better at finding some of the more deadly forms of breast cancer.

How much better? No one was sticking their neck out to say immediately after results of DMIST were published. The statistics generated in the study require some sophisticated interpretation. Suffice to say that with everything else digital mammography has going for it, the endorsement it received from DMIST guarantees its future.

Radiology has barely begun to tap the many features that come naturally to digital mammography, such as computer-assisted diagnosis and tomosynthesis. This and other technologies will eventually make radiologists better readers. The digital exam may prove to be the sort of disruptive technology that finally elevates mammography from its status as radiology's unwanted stepchild into one of its stars.

The next few months will tell whether the cost of the technology will inhibit this transformation. There is no evidence that the market is price-insensitive to what is now suspected to be a better way to screen for breast cancer. Given the low reimbursement for all forms of mammography, the cost-effectiveness of digital exams becomes hugely important. If the unit cost of a digital mammogram for cancer screening can be kept to an amount only marginally higher than a film study, then market demand for digital should soar.

What appears likely is that the soft-copy reading of mammography will gradually centralize, probably at locations that provide integrated breast care. This is perhaps the surest way for mammographers to develop the expertise they need to read studies quickly, well, and perhaps even profitably. Finding small, curable cancers is what mammography is all about, and where it is done well, it has never been done better. Digital mammography will advance the quality of service at these centers of excellence.

While DMIST results were mostly predictable, their impact will nevertheless be far-reaching. The sanction that a rigorous multi-center study provides is often very positive to the market acceptance of any new medical technology. Digital mammography is now in radiology's fast lane. ■



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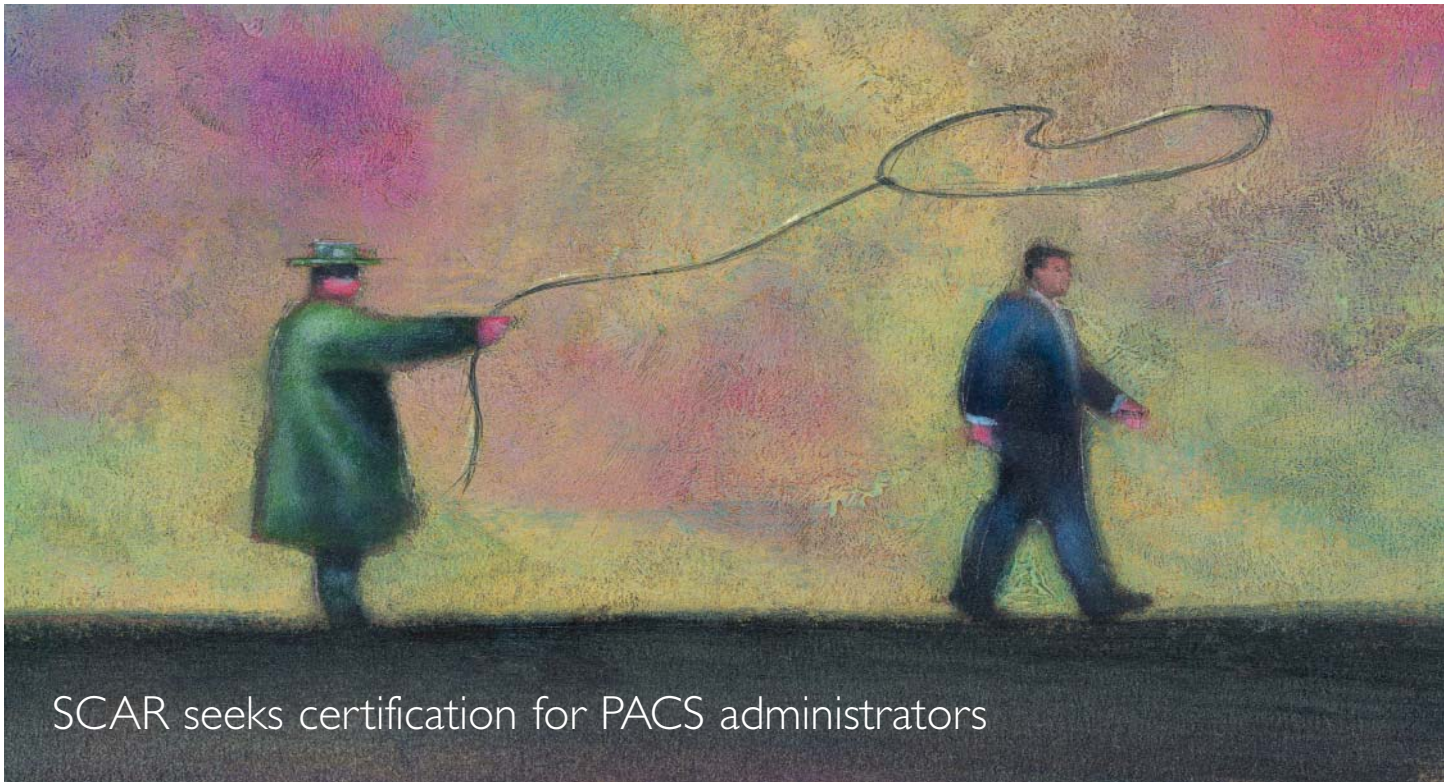
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SCAR seeks certification for PACS administrators

How do you recognize a top-notch PACS administrator when you see one?

Until now, it's been almost impossible to distinguish those who can do the job from the pretenders. The Society for Computer Applications in Radiology is eager to reduce the guesswork in this process.

PACS administrator certification was one of the featured topics at the 2005 SCAR meeting. The society has taken the first steps toward creating a program to certify PACS administrators. The initiative was discussed at length at the meeting, where an organizational and information-gathering forum was held the first day. Following this session, nearly 100 people volunteered to take part in SCAR's effort to craft a certification program for PACS professionals.

The society is designing a PACS administration certification program within medical imaging that will define the basic skills and capabilities needed by PACS administrators. It will then set minimum standards for the profession, noted Anna Marie Mason, SCAR executive director.

A spectrum of members within the PACS community will be consulted in this process, Mason said.

One specific challenge of PACS administration is that it requires a skill set that bridges the domains of radiology technologist, information systems analyst, and radiology administrator, noted Paul G. Nagy, Ph.D., director of the Radiology Informatics Lab at the Medical College of Wisconsin. For PACS to be successful, Nagy added, the tasks required for implementation and operation need to be firmly established in the framework of a professional discipline. ■

PACS forum adds track on volume visualization

The 10th annual Digital X-ray and PACS Forum is scheduled for March 4-8 in Hilton Head, SC. An educational track on volume visualization will be included for the first time as part of the program, joining tracks on digital mammography and digital x-ray/PACS.

The forum is open to all radiology professionals, including radiologists, technologists, mammographers, physicists and healthcare administrators. Attendees can earn up to 32 hours of CME/CE credit. The event is supported by an educational grant from FUJIFILM Medical Systems USA.

For more information, visit www.aafmed.com/dxpac. ■

A little TLC extends life of CR imaging plates

LIVINGSTON, NJ: From a physics point of view, there is no limit to the number of times most imaging plates (IPs) can be used in computed radiography. But while the radiation to which it is exposed may have no discernible effect on the plate, the same cannot be said for the banging and crashing it can receive at the hands of careless technologists.

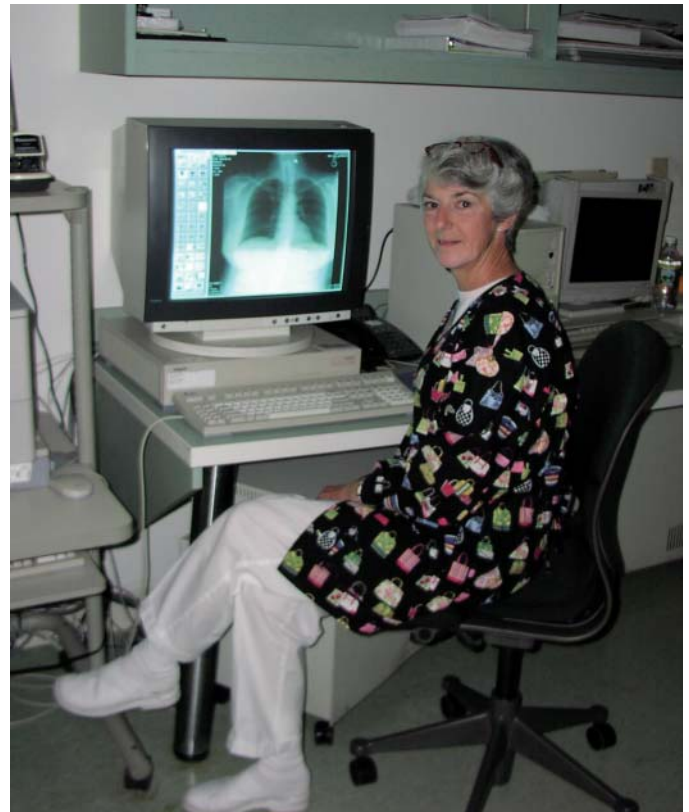
Either flexible or rigid, the typical plate rarely needs to be replaced after about three years of service. By then, scratches, scuffs, cracks and contamination with dust and dirt have visibly degraded the quality of images extracted from the plate.

At most sites, new plates costing between \$300 and \$500 are purchased to replace the old. The cassettes in which the imaging plates are held may in some cases also need to be replaced if they are dropped or damaged, or with some systems, must be replaced along with the plate. Because of the expense, many hospitals feel the need to include imaging plate and cassette replacement funds into their capital budget when purchasing CR.

A very different scenario has played out, however, at Saint Barnabas Ambulatory Care Center in Livingston, NJ. Here, Fuji Computed Radiography's flexible imaging plates and cassettes first used in 1998 are still in service. Respect for valuable equipment and a regimen of preventative maintenance have helped to assure the longevity of the equipment at the facility. Saint Barnabas proves that an annual replacement budget is not a necessity if basic recommendations for care are followed and the imaging plates and cassettes are handled with a little TLC.

Reggie O'Brien, R.T., is the person responsible for seeing that the plates are handled carefully. She has worked for Saint Barnabas Health Care System for 23 years as chief technologist for the Radiology Center. The last seven years have been at the center's location within the ambulatory care facility. She is, by her own description, a perfectionist at her job.

"I worked for a group of radiologists for 10 years before I came to Saint Barnabas and their policy was, if you break something, the cost comes out of your profit-sharing," O'Brien said. "I learned quickly that if I took good care of things, I had more money to take home."



Technologist Reggie O'Brien has instilled in her staff the need to handle all equipment in the department with respect.

O'Brien had never worked with CR until the Imaging Center opened in 1998. She has since trained approximately 20 diagnostic technologists in the proper use of the facility's three Fuji AC-3CS/ID readers.

All techs are instilled with a respect for the technology during their on-site training in CR. The department keeps a log in which it notes when imaging plates were put into service, and when and how the plates were cleaned. Plates are wiped off with a dry cloth monthly, and cleaned with anhydrous ethanol as needed. Cassettes are wiped with soap and water, and hinges checked to make sure they work properly. Any cassette that is visibly damaged is disposed of to avoid a possible jam in a plate reader.

The inside of the plate reader also receives preventative maintenance by Fuji service personnel twice a year.

Administrative Director Barbara Richardson is proud of the fact that her department is just now beginning to replace cassettes seven years after they were purchased. And while she is delighted with the performance of the Fuji CR readers, she is ready to benefit from the more advanced capabilities offered by newer systems.

"You want to be cost-effective with your equipment, but you also want to upgrade when the time is right," Richardson said. ■

Multicenter
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Digital mammography has taken a major leap forward with the publication of findings from a multicenter trial that it is statistically better than film at detecting cancer in women who are under 50, have dense breasts or have not yet gone through menopause.

The highly anticipated results from the Digital Mammographic Imaging Screening Trial (DMIST) involved 49,500 women at 33 sites in the U.S. Devices from four manufacturers were used in the trial, including Fuji's CR mammography (FCR_m) unit, the most popular digital mammography technology in the world.

DMIST showed that for the entire population of women studied, digital and film mammography had very similar levels of accuracy in cancer detection. The results, which were published in September in the *New England Journal of Medicine*, will give clinicians better options in deciding who will benefit most from the various forms of breast disease management, said Etta Pisano, M.D., the lead investigator of the study.

The trial proved that digital mammography is statistically better than film mammography for screening women in three major categories, which combined represent 65% of all patients enrolled in the trial, noted Pisano, who is

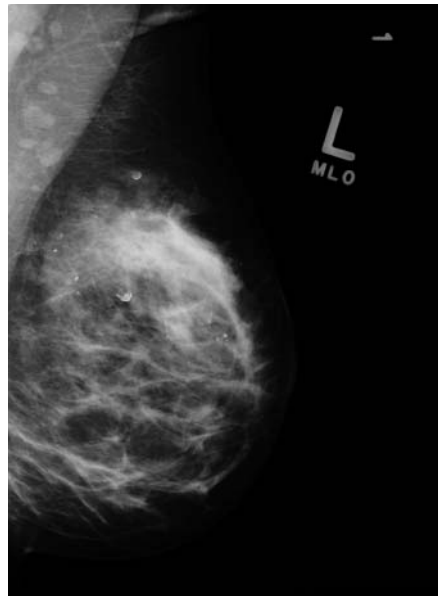
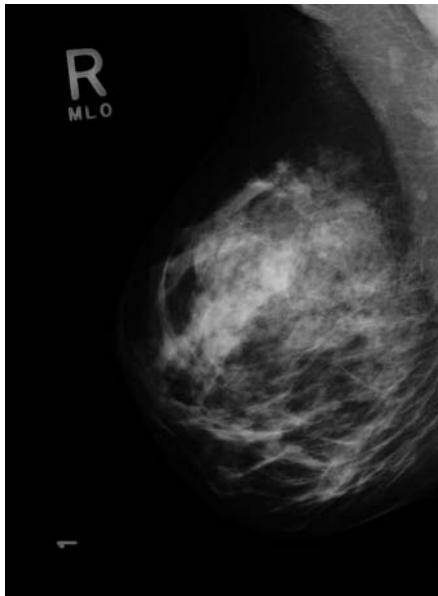
chief of breast imaging at the University of North Carolina at Chapel Hill.

"I'm very proud of this study, and believe the results are important for all women. Though we have yet to finish our cost-effectiveness analysis, those results will be available soon," she said.

Pisano added that she believes the cost of digital mammography will drop when Fuji receives pre-market approval for sale of its FCR_m device from the Food and Drug Administration (FDA). This will make the new technology more accessible, she added.

An estimated 40% of women undergoing screening mammography have dense breasts, and are thus prime candidates for the digital exam, based on DMIST findings. The trial found that digital mammography offers other advantages over film, including easier access to images and computer-assisted detection, improved means of transmission, retrieval and storage of images, and the potential use of a lower average dose of radiation without a compromise in diagnostic accuracy.

Only 8% of the estimated 9,000 breast cancer screening centers in the U.S. use digital systems. The DMIST results are expected to stimulate demand for digital exams



Digital mammogram showing a normal breast (right MLO) and a breast exhibiting microcalcifications and architectural distortion (left MLO).

among patients, which will likely prompt healthcare facilities to seek high-quality, cost-effective solutions for their full-field digital mammography (FFDM) needs, said Andrew Vandergrift, national program manager of Women's Healthcare Imaging Systems at Fuji.

"This is a major breakthrough in breast imaging," Vandergrift said. "Facilities have been anxiously awaiting these results before making a commitment to digital mammography. Many have long recognized workflow efficiency benefits of digital, and now have confirmation that it offers advantages over the gold standard of film screen."

The Fuji CR mammography system will be differentiated from other FFDM systems by virtue of its 50-micron pixel sampling, 24 x 30 cm field of view, multi-room capability, multi-modality imaging, and affordability.

More than 20% of all the exams evaluated in DMIST were acquired with FCR_m technology. These test sites included the University of North Carolina, Lahey Clinic in Burlington, Mass., UCLA and the University of California at Davis.

"Our first-hand experience with Fuji's technology revealed that it offers many advantages," said J. Anthony Seibert, Ph.D., a professor of radiology in the UC Davis Health System. "The use of Fuji's patented dual-side reading technology and 50-micron pixel sampling provided high diagnostic image quality, plus it is extremely cost-effective, making it a very attractive solution for facilities looking to go digital."

Because of Fuji CR_m's multi-room capability, a facility's cost per exam room is expected to be less than half the cost of digital systems currently on the market. Digital exams are in some instances reimbursed at a slightly

higher rate, but these payments have not been sufficient to date to convince a large number of facilities to make the investment in FFDM. In 2004, an estimated 410 digital mammography units were shipped to U.S. customers, compared to about 200 in 2003.

The National Cancer Institute, which sponsored DMIST, estimates that 210,000 women will be diagnosed with breast cancer in the U.S. this year, making it the most commonly

diagnosed cancer in women. An estimated 40,000 will die of the disease this year in the U.S.

"This digital mammography study demonstrates how new technologies are expanding our ability to detect breast cancer earlier in more women. It corroborates NCI's commitment to exploring advanced technologies in a wide range of clinical applications and the critical role they can play in making cancer a manageable disease," said NCI Director Andrew C. von Eschenbach, M.D.

During the course of the DMIST study, 335 women were diagnosed with cancer. In general, cancers detected by either film or digital mammography were similar in histology and stage.

However, the cancers detected by digital mammography and missed by film in women under 50, women with dense breasts and in pre- and peri-menopausal women included many invasive medium and high-grade *in situ* malignancies. These tumors, which were confined to the breast at diagnosis, are precisely the lesions that must be detected to save more lives through screening, according to DMIST investigators.

In situ malignancies are those confined to the breast duct without invading the surrounding tissue and are known as DCIS, or ductal carcinoma *in situ*.

The American College of Radiology and the American Cancer Society recommend annual screening mammograms for asymptomatic women 40 years and older, with screening exams possibly started at an earlier age for women with higher risk. The FDA reports that there are about 33.5 million mammography procedures performed each year in the U.S., of which about 70% are screening exams. ■

New dual-side imaging plate reduces dose while maintaining quality

ALARA—“as low as reasonably achievable”—is the ethical principle and responsibility of all radiographers; that patients should not be exposed to radiation in excess of what is required to produce images of diagnostic quality. The health risks inherent to radiation exposure are especially acute in children, who are ten times more sensitive to the effects of radiation than adults.

One common application of the ALARA principle is the use of x-ray-beam collimation, which directs radiation to those tissues and organs needing examination and minimizes exposure elsewhere in the body. A new dual-side imaging plate and cassette developed for computed radiography (CR), and specifically targeted to pediatric imaging, is another example of ALARA.

Using a combination of Fuji technologies, both computed radiography readers and newly developed image plate technology, facilities in the United States and abroad have been able to reduce radiation dose by at least a third while maintaining—and in some cases improving upon—the accepted standard of pediatric imaging. Results were obtained using Fuji’s ClearView-CS computed radiography system that employs dual-side plate reading technology and new dual-side emitting imaging plates with a thicker layer of phosphor—called ST-BD plates. The plate design permits the plates to collect even more image information which is captured by the dual light collection capability of the CR reader.

Independent dose reduction investigations of the potential benefits of computed radiography in pediatric imaging have been conducted and will continue at sites including Providence St. Vincent Medical Center in Portland, Ore., Children’s Hospital Boston, Kawaguchi Municipal Medical Center in Japan, and Turku University Hospital in Finland.

Avoiding dose creep

Dose reduction is a cornerstone of pediatric imaging, said Dr. Lee Ball, radiologist and surgeon at Providence St. Vincent. Research done at her institution found that radiation could be reduced by up to 40% without sacrificing image quality. In a blinded study, radiology technologists used both the new dual-side image plates



ClearView-CS plate reader features Fuji’s patented dual-side reading technology and 50-micron pixel sampling.

and standard single-side plates on several hundred patients admitted to the hospital’s neonatal intensive care unit.

“Dr. Ball and her staff were ecstatic about being able to lower dose for neonates,” said Jason Trump, the Fuji imaging specialist assigned to St. Vincent. “Her heart was really in that aspect of the study.”

While radiation exposure poses only a very small individual risk of cancer, it becomes a greater public health issue when a large number of examinations are multiplied by that risk. Radiation exposure is cumulative, and a newborn baby has an expected life span of at least 75 years.

Efforts to pursue ALARA in pediatric imaging have long been thwarted by the technical limitations of x-ray technology. In general, the amount of radiation used in a radiographic study determines the noise present in the image. The more noise, the less image processing that can be used without producing artifacts. Noisier images are also more likely to be rejected by radiologists, who are trained to be skeptical of noisy images, which may limit the visibility of subtle lesions.

CR images produced with higher levels of radiation are usually crisp and unlikely to be rejected by radiologists. Technologists are quick to notice this, resulting in a phenomenon known as “dose creep.” Using more radiation than necessary to produce a diagnostic-quality image violates the ALARA principle and cumulative effect of radiation exposure may put the future health of patients at risk.

The higher DQE (detective quantum efficiency) and 50-micron spatial resolution of Fuji’s ST-BD plates creates images with high clarity and lower noise. The system appears to afford users the potential to significantly reduce dose and at the same time maintain acceptable image quality.

“The 33% dose-reduced images with ST-BD carry the proper diagnostic information,” said Dr. Hellevi Rikalainen, pediatric radiologist at Turku University Hospital. “This is very important with the newborn patient population, especially those treated in neonatal ICUs in which circumstances demand repeated (frequent) exams” (to assess changes in patient condition).

The Turku group observed that both bone and soft tissue can be clearly depicted in CR images made with the new plates. The Finns also noted that improved vascular shadows are depicted through the heart.

Images show atrial catheters

A particular challenge in pediatric radiology is the imaging of respiratory distress syndrome (RDS), a common disorder of premature babies. At Kawaguchi Municipal Medical Center, the primary objectives of investigators was to properly image the reticulogranular patterns of the lung field and achieve a good balance between image resolution and the acceptable level of noise.

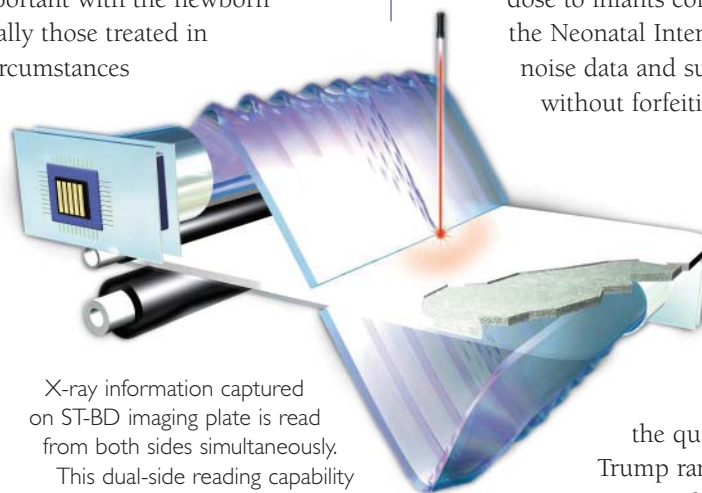
Among other findings, the Japanese group noted that in the CR images it was easy to recognize very thin catheters threaded into the right atrium of neonates with RDS.

“When it comes to the rendering of reticulogranular patterns of respiratory distress syndrome,” said Dr. Hiroko Hara, radiologist at Kawaguchi. “ST-BD has reasonably great

potential for making improvements in the image quality of chest exposures in newborns.”

As part of the technical support provided in the dose reduction study at Providence St. Vincent, Fuji imaging specialist Trump noted that he worked together with Dr. Ball to optimize the CR algorithms to obtain the image density and contrast she preferred to make diagnoses in her tiny patients.

Dr. Ball’s group was able to reduce radiation dose through the increased efficiency of the ST-BD image plate and by increasing kVp and decreasing mAs. The overall dose was lowered approximately 30 to 40% using the new system in comparison to the standard CR imaging plate, Trump said. He added that with the application of Fuji’s FNC (flexible noise control), an advanced processing parameter, it may be possible to further improve image quality in lower dose images and additionally reduce radiation dose to infants commonly imaged, often daily, in the Neonatal Intensive Care Units. FNC extracts noise data and suppresses noise levels in images without forfeiting diagnostic information.



X-ray information captured on ST-BD imaging plate is read from both sides simultaneously. This dual-side reading capability provides higher DQE, which decreases image graininess.

Early in the study at St. Vincent, Trump was called upon to inspect images with a consistent symmetrical noise that had a fabric-like pattern. The noise was apparent throughout the image, seriously degrading the quality of the images. Initially, Trump ran some tests and adjusted image parameters, but it was only when he turned his attention to patient image environment that he discovered the cause and solution to eliminate the artifact.

“The babies were imaged while lying on a thin fleece blanket. The fine blanket fibers displayed in the image as noise. We were all amazed that the image processing displayed that level of information,” Trump said. “When they switched from fleece to chux pads the artifact went away.”

In addition to the ST-BD imaging plate, Fuji also offers a high definition imaging plate, HR-BD, which also features the dual-side emission technology. The HR-BD plate is designed for the highest detail applications.

The development of 50 micron imaging coupled with the increased efficiency of the dual-side emitting imaging plate further advances high resolution, low noise images. Fuji is dedicated to improving image quality while keeping the dose “as low as reasonably achievable”. ■



By Kathy Pitura,
Research Specialist,
FUJIFILM Medical Systems, USA.

How to choose the right grid for your CR exam

Technologists who strive for superior results with computed radiography must be no less diligent at reducing scatter radiation than they are with screen-film radiography. Both stationary and reciprocating grids improve CR image quality by absorbing much of the scatter that would otherwise diminish image contrast and obscure detail. Fortunately, new skills are not needed to identify the right grid as the selection criteria for CR is the same as it is for film-screen exams. Grid type, ratio, frequency, body part thickness and exposure are among key factors to consider.

X-ray tubes used in all forms of diagnostic radiography generate a beam of radiation comprised of photons of various energies. Most of this radiation passes through the patient and strikes an imaging plate, transferring useful information from which an image is made. The patient absorbs some of the lower energy waves and the rest scatters in many directions. Scatter that reaches the imaging plate is observed as noise that degrades image quality.

Scatter radiation increases proportionate to the size of the irradiated field and the thickness or denseness of the part imaged. High kVp also increases scatter and makes scattered rays more energetic, increasing the possibility that they will reach the receptor. This scatter radiation must be controlled in order to obtain high-quality images of thicker body parts. While scatter cannot be entirely eliminated, a grid will minimize it.

Two types of grids

The two most commonly used grids in CR are focused and parallel. Both employ precision-designed strips of lead that are typically interspaced with aluminum. This design allows primary radiation that is traveling straight to reach the imaging plate while assuring that lower energy radiation in the form of multidirectional scatter is absorbed.

Parallel grids are made with the lead strips set vertically. This design is more forgiving of sloppy patient positioning, but is known to compromise image quality at the edges of the image. To avoid this cut-off problem, these grids should not be used for source-to-image distances of less than 48 inches. When a grid is used at a distance above or below its recommended range, or if the geometry of the beam does not match that of the grid, both primary and secondary radiation is absorbed.

In a focused grid, lead strips are progressively angled from the center of the grid to align with the divergence of the x-ray beam. Each grid is thus focused to a specific distance or distance range. The lead strips in a focused grid absorb any scattered radiation that does not travel in the same direction as the primary beam, which reduces unwanted radiation from reaching the imaging plate.

Typical focal ranges are 40 to 72 and 60 to 90 inches. These minimum and maximum values tell the technologist the source-to-image distances that will avoid unwanted absorption of the primary beam. Images acquired out of the recommended range may produce images with grid cut-off. In these situations, increasing exposure factors will not improve image quality. Checking the geometry of the central beam to the grid and the recommended source-to-image distance will eliminate grid cut-off.

Another common cause of grid cut-off occurs when the central x-ray beam is not perpendicular to the grid. When this occurs, primary radiation is absorbed or cut off from reaching the image receptor, resulting in lost information.

Efficiency of scatter absorption

Grid frequency and grid ratio are used to describe the scatter absorption efficiency of each grid type. Grid frequency is expressed as lines per centimeter or lines per inch. The higher the frequency (the more lines per inch), the thinner and less obtrusive the grid lines appear in the image. Most grids are between 80 and 178 lines per inch. Grids with high frequency (130 and above) provide the best images. Grid lines should run along the long axis of the grid. This places the lines at a right angle to the direction in which laser scanning is done in the image plate reader.

Grid ratio is the relationship between the height of the lead strips and the space between them. The higher the grid ratio, the better the absorption of scatter radiation; the lower the grid ratio, and the more forgiving the grid becomes to positioning error.

It is generally accepted that higher grid ratios provide more efficient scatter absorption. In practice, a 6:1 or 8:1 grid ratio is a good choice for a portable chest exam, allowing ease of use with adequate clean-up. For a portable image of the abdomen, hip or skull, a higher grid ratio such as an 8:1 grid provides superior clean-up

for thicker, denser body parts. A 10:1 or 12:1 ratio grid is a good choice for CR used in the radiology department where a multitude of exams are performed under a more fixed geometry. As scatter radiation increases with an increase in kVp and body thicknesses, higher grid ratio and at a higher level of kVp may be needed.

Grids are rarely required for CR of small body parts, such as fingers, hands and feet. When imaging a body part more than 10 centimeters thick, scatter increases and its detrimental effects—decreased contrast and detail—can be observed on the final image. It is good practice to use a grid to image knees and shoulders as well as for larger body parts to eliminate as much scatter as possible from reaching the imaging plate.

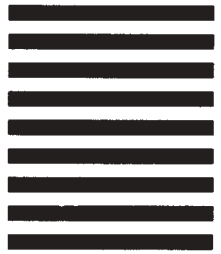
Digital images, including those produced by CR, are displayed in a pattern of tiny rows of pixels. Lines projected on the imaging plate from a stationary grid can generate a wavy, lined artifact known as a moiré pattern. Reciprocating grids (or buckys), which are used in radiographic tables in the imaging department, blur the

grid lines and eliminate interference with the digital matrix. Many x-ray exams require a stationary grid, however. For example, stationary grids are used to control scatter when imaging critically ill patients in the x-ray room, operating room, emergency department or at the bedside. To reduce interference caused by stationary grids, technologists should pay attention to their proper selection and alignment. High-frequency grids also reduce the possibility of moiré pattern.

With all this said, it would seem that the highest grid ratio, with the highest frequency, would always be the best choice. However, grids with the most efficient clean-up require more attention to accurate positioning and recommended focus distance. An increase of grid ratio also requires an increase in exposure factors that raises the radiation exposure to the patient, which is often an unacceptable trade-off. The choice of the correct grid is thus one that requires careful consideration of several interrelated variables. ■



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What is your profession?

- Radiologist
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survey results

Due to the minimal response to the survey in the Summer/Fall Issue, there are no significant results to report.

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